TM 11-647

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO RECEIVING SET AN/FRR-38

DEPARTMENT OF THE ARMY • MARCH 1955

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 280-volt to 300-volt plate and power supply circuits, or on the 115-volt ac line connections.

DO NOT TAKE CHANCES!

TECHNICAL MANUAL
No. 11-647

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *18 March 1955*

RADIO RECEIVING SET AN/FRR-38

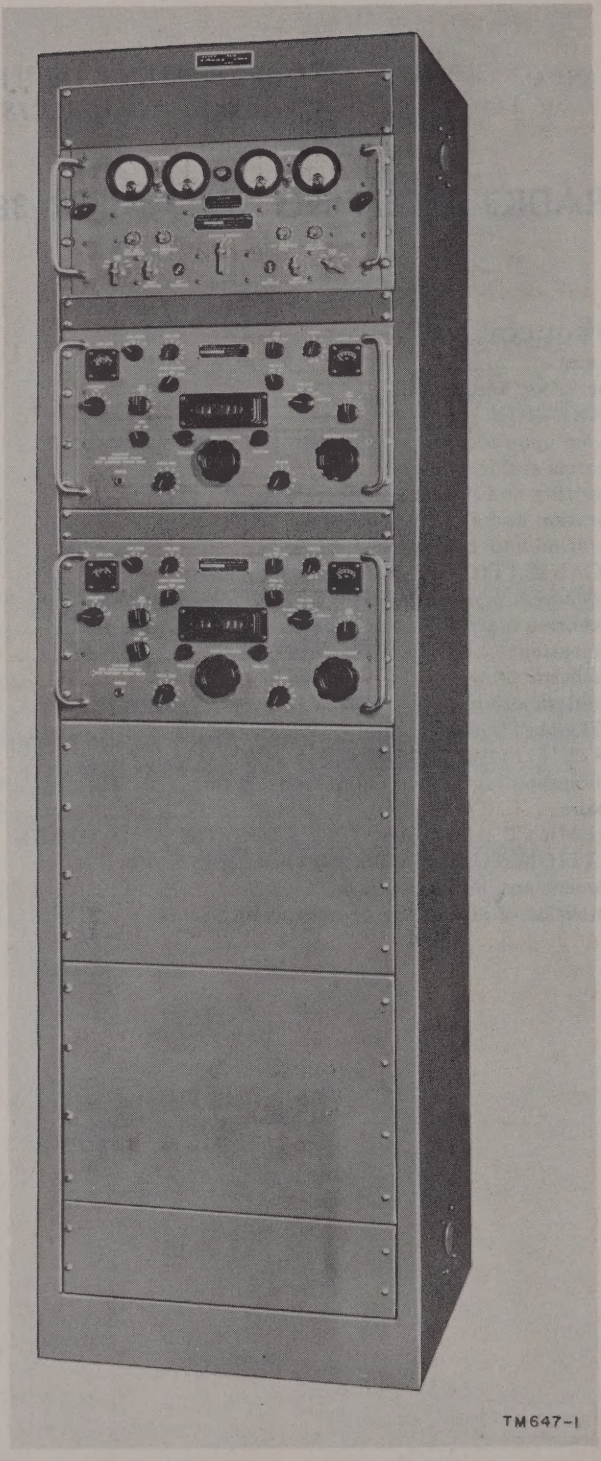

Figure 1. Radio Receiving Set AN/FRR–38.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains instructions for the installation, operation, and maintenance of Radio Receiving Set AN/FRR–38 (fig. 1).

b. Radio Receiving Set AN/FRR–38 consists of two Radio Receivers R–390/URR, one Frequency Shift Converter CV–116/URR, one Electrical Equipment Cabinet CY–1119/U, and one Installation Kit for Radio Receiving Set AN/FRR–38. Operation, maintenance, and repair of Radio Receiver R–390/URR is covered in TM 11–856.

c. Forward comments on this publication directly to the Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, N. J., ATTN: Standards Branch.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army materiel and equipment and in performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army); Navy Shipping Guide, Article 1850–4 (Navy); and AFR 71–4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. DD Form 535, Unsatisfactory Report, will be filled out and forwarded as prescribed in SR 700–45–5 and TO 00–35D–54.

d. DA Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 30).

e. DA Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 31).

f. Use other forms and records as authorized.

3. Nomenclature Assignments

A list of the nomenclature assignments for the components of Radio Receiving Set AN/FRR–38 is given below. A common name is indicated after each item.

Nomenclature	Common name
Radio Receiving Set AN/FRR–38	Receiving set.
Radio Receiver R–390/URR	Receiver.
Frequency Shift Converter CV–116/URR.	Converter.
Electrical Equipment Cabinet CY–119/U.	Cabinet.
Installation kit for Radio Receiving Set AN/FRR–38.	Installation kit.

Section II. DESCRIPTION AND DATA

4. Purpose

a. The receiving set is used for dual diversity reception of frequency-shift keyed (fsk) radioteletype signals. Either single-channel or time division multiplex signals may be received. The receiving set can be continuously tuned over the frequency range of 500 kilocycles (kc) to 32 megacycles (mc). The frequency stability is so excellent that unattended reception of radioteletype signals is permissible under normally encountered conditions.

b. The output of the receiving set is delivered from the converter in neutral direct current (dc) pulses at keying speeds as high as 100 dot cycles per second (cps). The equipment is operated from a 115-volt ac, 50–60 cps power source and should be used in fixed installation only.

5. System Application

a. The receiving set is the radio receiving link in a radioteletype communications system. The relationship of the receiving set to other equipments that are required to form a space diversity radioteletype communications system is shown in figure 2. A space diversity transmitting system uses only a single transmitter and antenna. Dependability against signal fading is obtained by placing the receiving antennas at least 600 feet apart. Normally, a radio signal will not fade simultaneously at two points separated by that distance.

b. In frequency diversity transmission, two transmitters that operate at different frequencies are used. The receivers of the receiving set are tuned to these separate frequencies. A common antenna can feed both receivers through a multicoupler. The amount of frequency separation may be very small and is limited by the selectivity of the receivers involved. This system provides dependable communications because two signals of differing frequencies usually do not fade simultaneously.

c. If the signal is traced through the space diversity system (fig. 2), the dc pulses of a sending teletypewriter are delivered through a control unit to a frequency shift exciter. This exciter delivers frequency-shifted signals to the amplifying stages of a transmitter. The output of the trans-

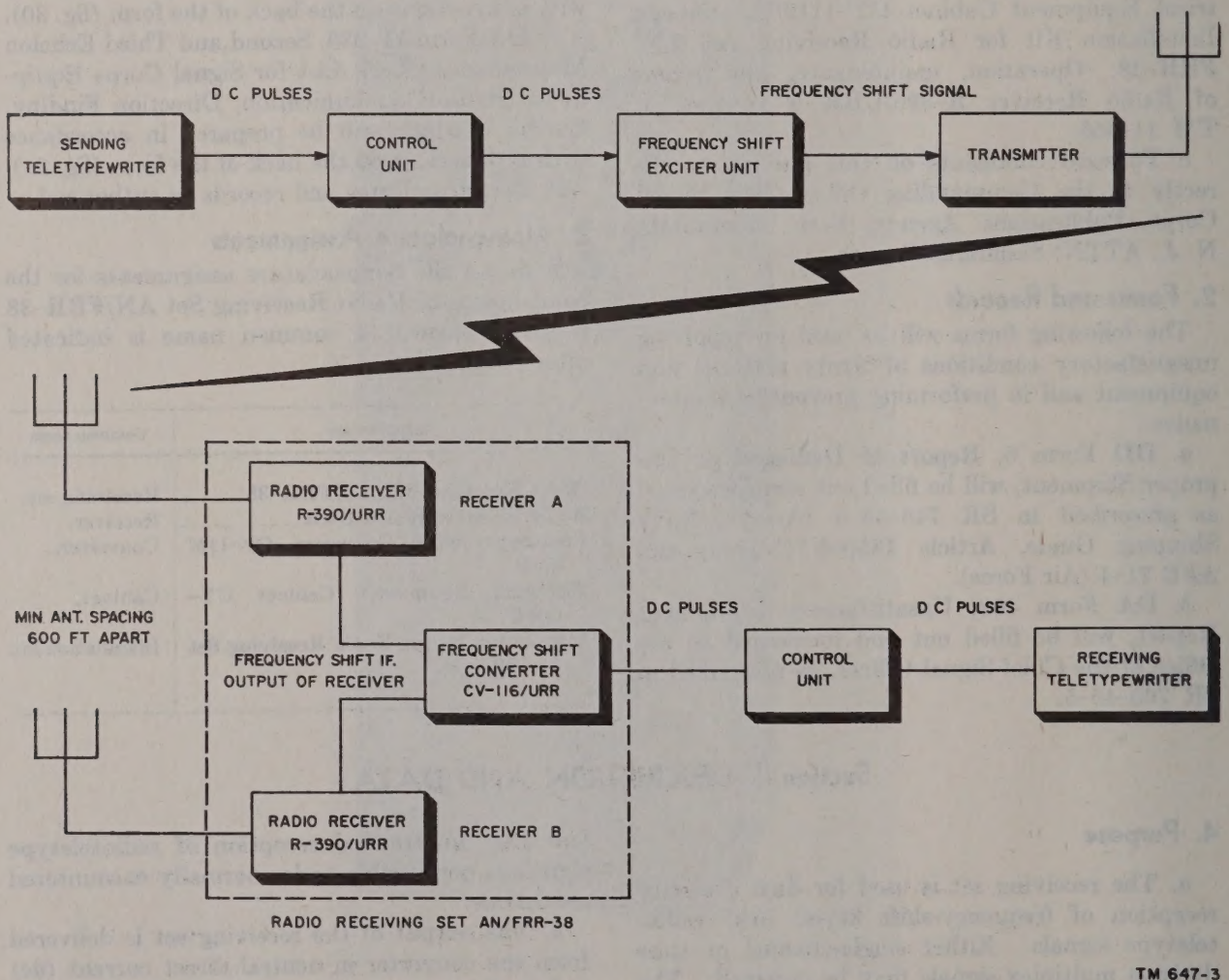

Figure 2. Radio Receiving Set AN/FRR–38, system application.

mitter is transmitted to two receivers which use two antennas in a space diversity installation. The intermediate frequency (if) output of each receiver is delivered to the applicable input channel (A or B) of Frequency Shift Converter CV–116/URR, which combines the two signals and converts their frequency-shift component to dc pulses. These pulses, when delivered through a control unit, are used to key the dc loop circuit of a receiving teletypewriter.

d. The use and precise character of the *control unit* that follow the receiving set in figure 2 depend on the particular system in which the receiving set is employed. Simple systems, in which the output of the converter is delivered over lines that are less than 1 mile in length, may use an adapter-connector (in place of the control unit) to match the output connectors of the converter with those of a teletypewriter. In applications where receiving teletypewriters are more than a mile from the converter, the control unit is replaced by a repeater or a tone keyer. A tone keyer, as well as specialized terminal equipment, is used in an installation that receives time division multiplex signals.

6. Technical Characteristics

a. Radio Receiver R–390/URR.

Type of circuit	Triple-conversion superheterodyne on eight lowest frequency bands; double-conversion superheterodyne on all other bands.
Frequency range	0.5 to 32 mc (in 32 steps).
Type of signals received	A1—cw, A2—mcw, A3—voice amplitude modulation (am), F1-fsk.
Type of tuning	Continuous; frequency read directly on countertype indicator.
Method of calibration	Built-in crystal-controlled calibration oscillator.
Calibration points	Every 100 kc.
Audio power output:	
600-ohm unbalanced line.	500 milliwatts (mw).
600-ohm balanced line.	10 mw.
Phones	5 mw.
If selectivity	100 cps to 16 kc bandwidth, in 6 steps.
Intermediate frequencies:	
First variable if (used only on eight lowest-frequency bands).	9 to 18 mc.
Second variable if (all bands).	2 to 2.5 mc on lowest step; 2 to 8 mc on all other steps.
Third (fixed) if	455 kc.
Sensitivity:	
Am signals	3 microvolts (uv) or better.
Cw signals	1 uv or better.
Power source	115/230 volts alternating current (ac) ±10%, 48–62 cps.
Power input:	
115/230 volts ac	270 watts total; 170 watts with oven heaters off.
Number of tubes	33 (including ballast tube RT–512).
Antennas:	
Unbalanced	Random length vehicular-mounted whip or straight-wire.
Balanced	125 ohm nominal terminating impedance; matches 70 to 200 ohm line or unbalanced transmission line with adapter.
Temperature range	−40° C. (−40° F.) to 55° C. (131° F.).
Altitude	Up to 10,000 ft.
Weight	80 lb.

b. Frequency Shift Converter CV–116/URR.

Converter if. center frequencies:	
Channel A frequency	50 kc.
Channel B frequency	29.3 kc.
Input frequency	450 to 510 kc.
Required minimum input voltage	100 uv.
Input frequency-shift range	150 to 1000 cycles.
Input impedance	50 ohms (aprx) ±20%.
Number of input channels	2.
Number of tubes	45.
Output	Mark .060 ampere. Space .0 ampere.
Power source required	115 volts, 50–60 cycles, single phase ac.
Power consumption	200 watts (aprx).
Weight	65 lb.

c. Electrical Equipment Cabinet CY–119/U.

Width of mounting centers	18.3125 in.
Overall width	21 27/32 in.
Height	76 in.
Depth	20½ in.
Convenience power receptacles, (fused, with master switch):	
Number	8.
Spacing	6 in center to center.

7. Packaging Data

a. When packaged for export shipment, the components of the receiving set are placed in moisture-vaporproof containers and packed in wooden export crates. A cutaway view of a typical component packed for export is shown in figure 3. The size, weight, and volume of each crate is indicated in the following chart:

Component	Number of crates	Height (in)	Width (in)	Length (in)	Volume (cu ft)	Weight (lb)
Receiver	2	21	32	32	12. 4	200
Converter	1	11¾	22½	27	4. 1	90
Electrical equipment cabinet	1	26⅜	27½	81½	34. 2	335
Installation kit	1	6	14½	23	1. 2	50
Total						675

b. The following chart gives the authorized contents of each case. Refer to the packing list attached to each case for the exact contents.

Case dimensions (in)	Contents	Notes
21 x 32 x 32.	1 Radio Receiver R–390/URR.	With tubes, pilot lamp, crystals, and fuses.
	1 Power Supply PP–621/URR.	With tubes.
	1 Electrical Power Cable Assembly CX–1358/U.	
	1 set running spares.	See paragraph 13.
	2 technical manuals.	
11¾ x 22½ x 27.	1 Frequency Shift Converter CV–116/URR.	With tubes, pilot lamp, crystals and fuses.
	2 Cords CG–409A/U.	
	1 Electrical Power Cable Assembly CX–2491/U.	
	1 set running spares.	See paragraph 13.
	2 technical manuals.	
26⅜ x 27½ x 81½.	1 Electrical Equipment Cabinet CY–1119/U.	
	1 set miscellaneous hardware.	60 oval-head screws (12–24).
		60 cup washers.
6 x 14½ x 23.	1 name plate (N1101).	
	1 caution plate (N1102).	
	6 angle brackets (A 1107 through A 1112).	1⅜ in. x 1¼ in. x 19 in.
	2 Adapter Connectors UG–971/U (CP1101, CP1102).	
	2 Plugs UG–573/U (P1101, P1102).	
	2 fuses (F1101, F1102).	10 amp-125 volts.
	1 set running spares.	Refer to paragraph 13.
	2 technical manuals.	
	1 set blank panels (A 1101 through A 1106).	2 size A (1¾ in. h).
		1 size B (3½ in. h).
		1 size C (5¼ in. h).
		2 size H (14 in. h).
	1 set miscellaneous hardware (H1101 through H1107).	8 slotted binding-head machine screws (2⅝ x 3/16 in.).
		12 slotted round-head machine screws (¼–20 x ⅝ in.).
		12 flat washers (¼ in. ID, ⅝ in. OD).
		12 split lock washers (¼ in.).
		12 square nuts (¼–20).
		2 slotted binding-head screws (10–32 x ⅜ in.).
		2 slotted binding-head screws (6–32 x ⅜ in.).
	2 ground straps (W1101, W1102).	6 in. long.

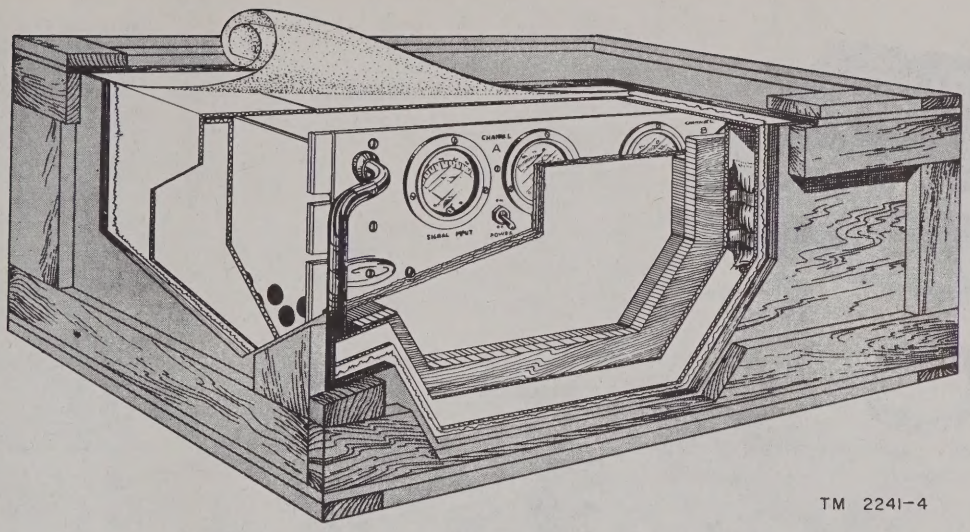

Figure 3. Typical component packed for oversea shipment.

8. Table of Components

(fig. 4)

Component	Required No.	Height (in.)	Depth (in.)	Width (in.)	Volume (cu ft)	Unit weight (lb)
Radio Receiver R–390/URR	2	10½	17¼	19	2. 0	80
Frequency Shift Converter CV–116/URR	1	8¾	17	19	1. 6	65
Electrical Equipment Cabinet CY–1119/U	1	76	20½	21 27/32	19. 7	225
Installation Kit for Radio Receiving Set AN/FRR–38	1					40
Total						490

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

9. Description of Radio Receiver R–390/URR

a. Radio Receiver R–390/URR (fig. 5) is a stable communications receiver that is capable of receiving radiotelegraph, voice, fsk, single-sideband, twin single-sideband, and continuous wave (cw) signals within the range of .5 through 32 mc. There are two of these receivers in the receiving set; they are positioned below the converter. The receiver employs unitized chassis construction (fig. 6), which breaks down into subchassis that may be removed with ordinary hand tools and are interchangeable with subchassis in other receivers of the same model.

b. The receiver has a self-calibration feature that enables the dial calibration to be accurate within 300 cps. Thus, it may be used as a frequency meter. For further information concerning the usability of the receiver, refer to TM 11–856.

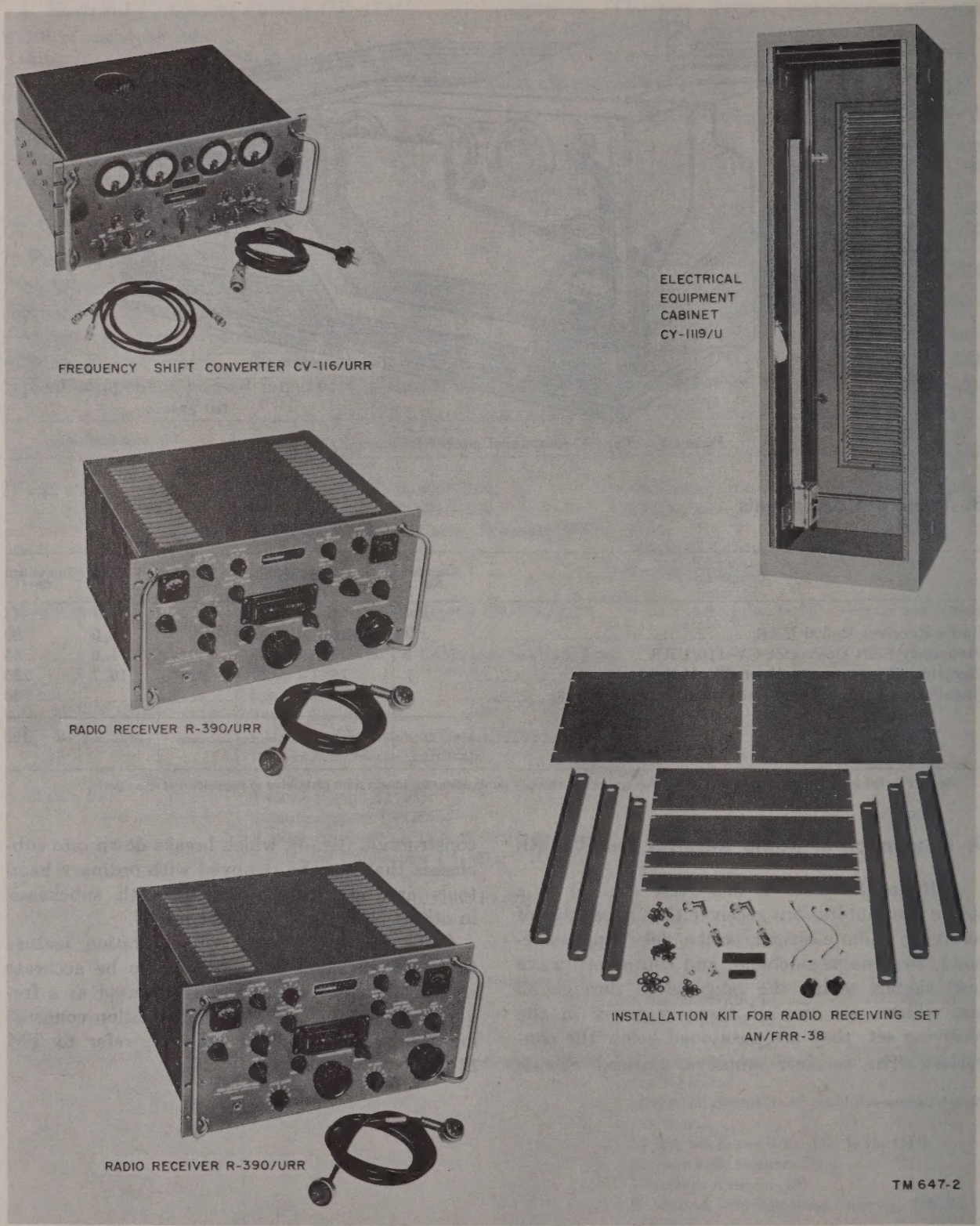

Figure 4. Radio Receiving Set AN/FRR-38, operating components.

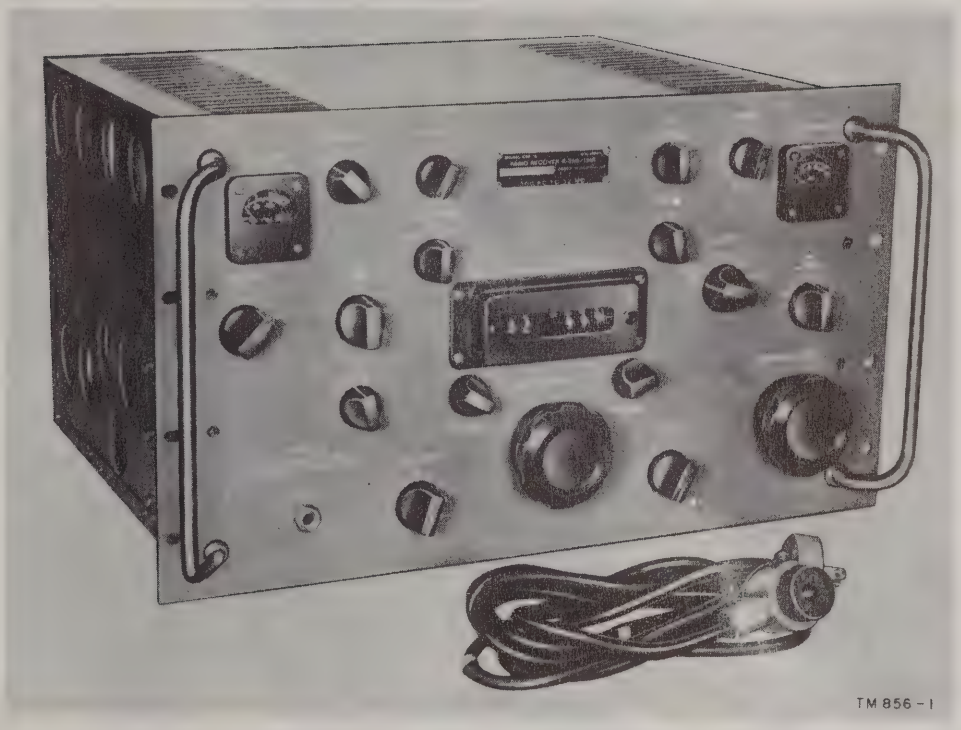

Figure 5. Radio Receiver R–390/URR.

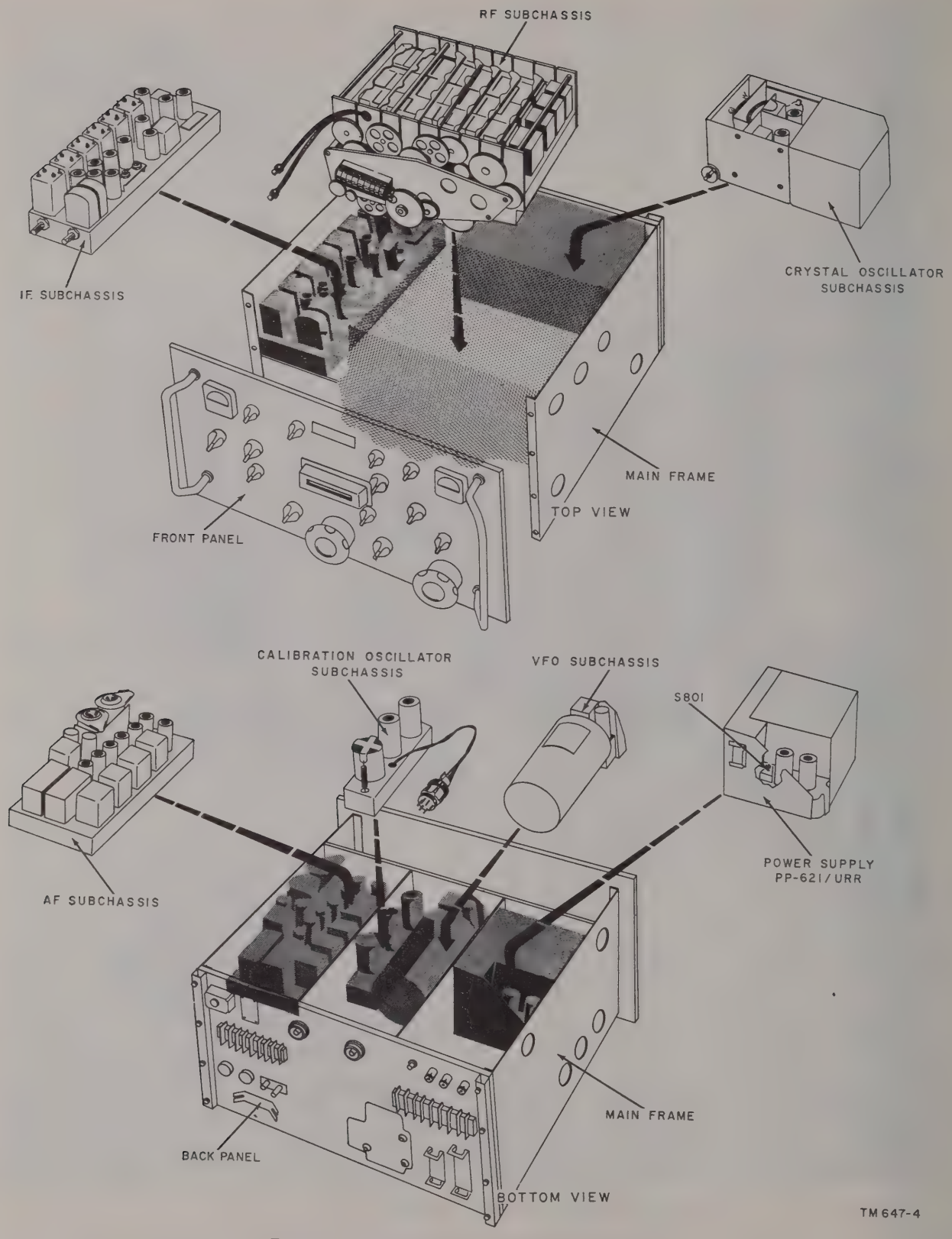

Figure 6. Radio Receiver R-390/URR, subchassis.

10. Description of Frequency Shift Converter CV–116/URR

(fig. 7)

a. Frequency Shift Converter CV–116/URR converts fsk input signals into neutral dc output pulses that key the energizing loop circuits of automatic receiving teletypewriter printers. The converter can operate at speeds as high as 100 dot cps.

b. The converter consists of two separate input channels that feed frequency-shift signals to a diversity section. There the two signals are combined in a common limiter, and the resultant signal is converted from a frequency-shift carrier into dc mark and space pulses.

c. The converter has self-contained meters to measure the various currents and voltages during normal operation and for troubleshooting, testing, and adjusting purposes. Besides operating in a diversity system, the converter may be fed with a single receiver to operate a teletypewriter printer. The dependability of this system relies on transmitting-receiving conditions. Under conditions of excessive noise, extreme distance, etc., it is not as dependable as a diversity system. For a more detailed description of the converter, refer to the manual for Frequency Shift Converter CV–116/URR.

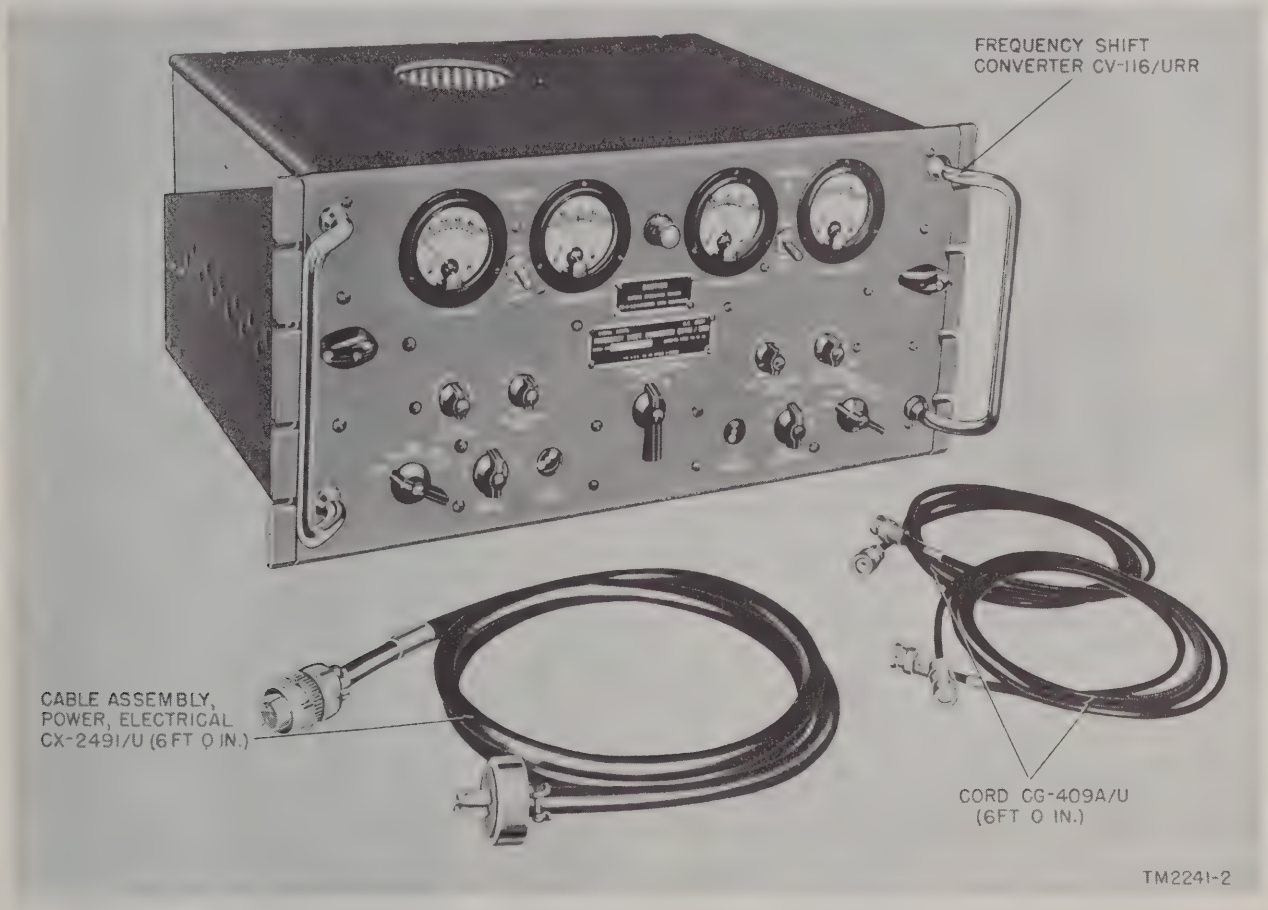

Figure 7. Frequency Shift Converter CV–116/URR.

11. Description of Electrical Equipment Cabinet CY–1119/U

(fig. 8)

Electrical Equipment Cabinet CY–1119/U is a 19-inch relay rack-type cabinet that is 76 inches high by 21 27/32 inches wide by 20½ inches deep. The cabinet includes a power switch, fuses, and a receptacle strip to provide easy access to a power source for the components mounted in it. The grey cabinet has a latched door at the rear through which the various interconnections of the components are readily accessible. The cabinet should be mounted in a fixed installation.

12. Description of Installation Kit for Radio Receiving Set AN/FRR–38

(fig. 9)

The installation kit for Radio Receiving Set AN/FRR–38 consists of the connectors, cables, and hardware that are necessary to install the components of the equipment in the cabinet. To install this kit, refer to paragraph 17.

13. Running Spares

A group of running spares has been packed separately with each receiver, converter, and installation kit. The spares are provided for all normally expendable items such as tubes, pilot lamps, fuses, and connectors. A list of the running spares that are packed with each of the components of the receiving set follows:

Component	Running spares (one set each)
Radio Receiver R–390/URR	2 tubes, type 3TF7.
	6 tubes, type 6AJ5.
	2 tubes, type 6AK6.
	1 tube, type 6BH6.
	3 tubes, type 6BJ6.
	6 tubes, type 6C4W.
	1 tube, type 12AT7.
	3 tubes, type 12AU7.
	1 tube, type 26Z5W.
	1 tube, type 5651.
	4 tubes, type 5749/6BA6W.
	1 tube, type 6082.
	4 dial lamps, type GE 327.
	6 fuses, ⅜ ampere, type 3AG.
	6 fuses, 3 ampere, type 3AG.
Frequency Shift Converter CV–116/URR.	1 panel indicator lamp.
	12 fuses, 3 ampere.
	1 crystal, 405 kc.
	1 crystal, 425.7 kc.
	4 tubes, type 5726.
	1 tube, type 6AQ5W.
	4 tubes, type 6AU6.
	1 tube, type 6BA7.
	4 tubes, type 5814.
	2 tubes, type 6X4W.
Installation kit	1 Adapter Connector UG–971/U.
	1 Plug UG–573/U.
	12 fuses, 10 ampere, JAN type F14–D–10ROA.

14. Additional Equipment Required

Because the receiving set is part of a complete radioteletype receiving system, the other components of the system are required for operation. A typical receiving system would include the control unit, the teletypewriter, the antenna and transmission line equipment, and the headsets.

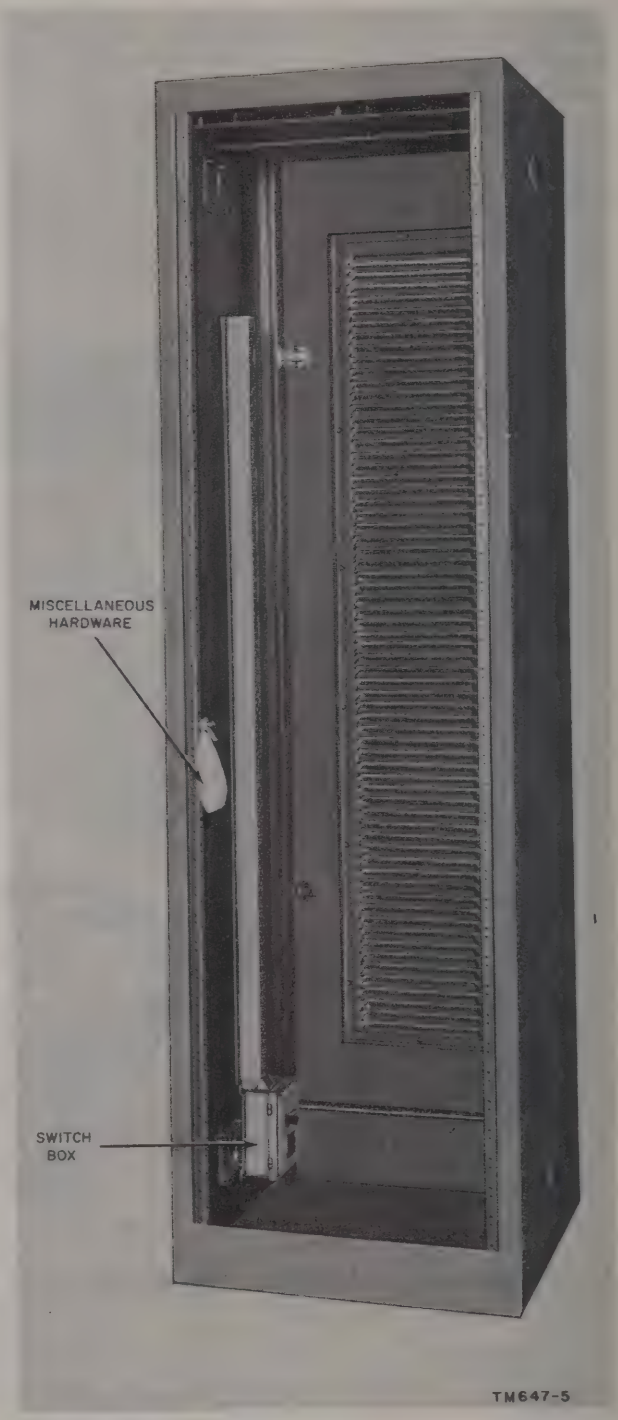

Figure 8. Electrical Equipment Cabinet CY–1119/U.

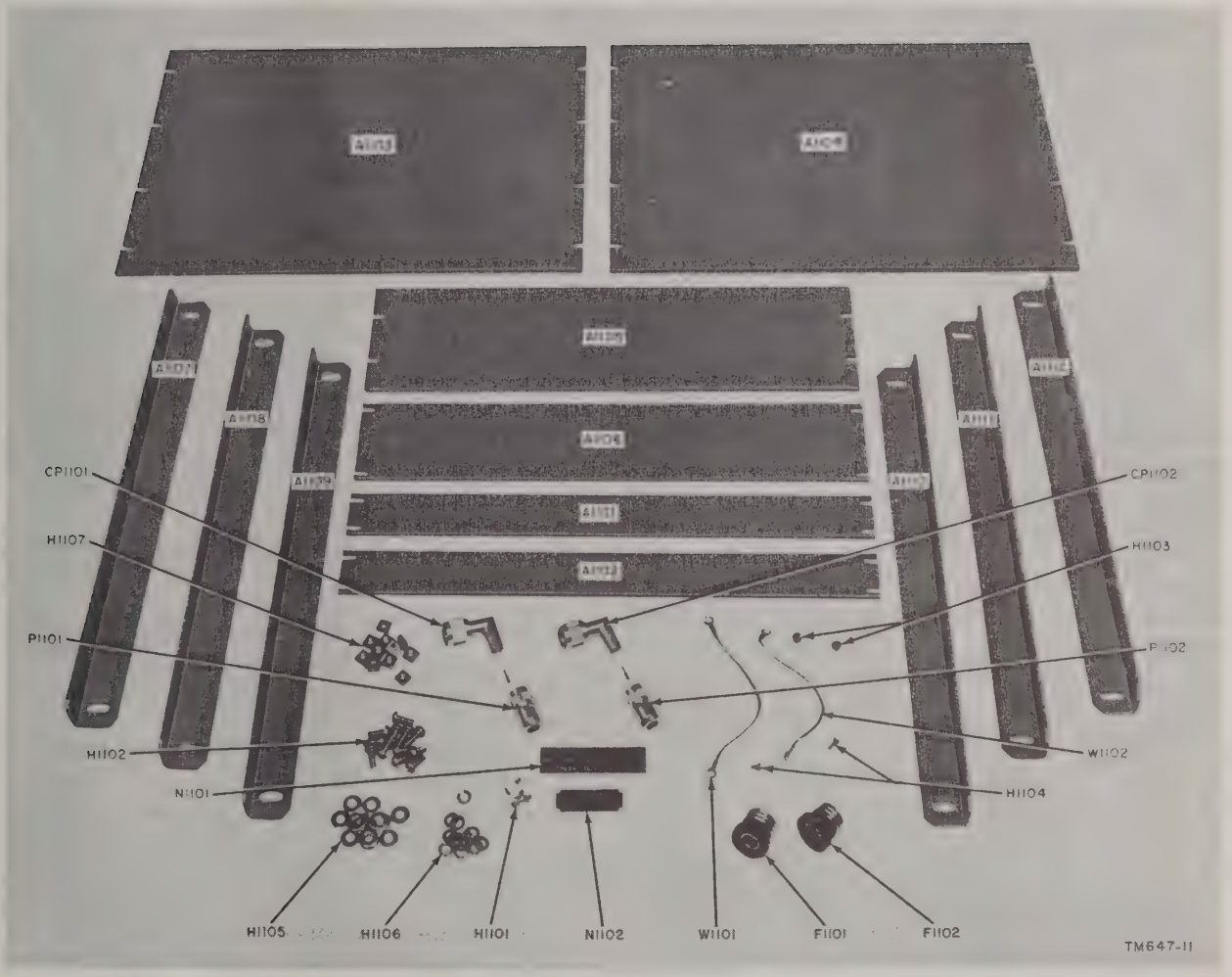

Figure 9. Installation Kit for Radio Receiving Set AN/FRR–38.

CHAPTER 2

OPERATIONS

Section I. SERVICE UPON RECEIPT OF RADIO RECEIVING SET AN/FRR–38

15. Siting

(fig. 10)

a. Exterior Requirements. The main consideration for locating any radio equipment is the siting of its antennas. If possible, site the antennas in a position where the immediate terrain is fairly level. Ground with good conductivity properties is most desirable. If possible, locate the antennas in such a way that nearby hills, densely wooded areas and other obstructions are not between the transmitting station and the receiving antennas. Be careful that the equipment is not located near overhead power lines, steel bridges, or other metallic structures. The equipment itself should be housed in the best building available for that purpose. If space diversity reception is to be used, a clear area, suitable for the erection of two receiving antennas, is required. These antennas should be located not less than 600 feet apart. Orient the antennas in relation to the direction of the received signal to take advantage of their directional properties (fig. 11). In figure 11, two common types of receiving antennas, the double doublet and the horizontal rhombic, are shown set up for operation in a space diversity system. A satisfactory double-doublet antenna for use between 2.5 and 20 mc is described in TM 11–2629. A double rhombic antenna, which is generally more efficient than any form of doublet antenna, is described in TM 11–2611. To prevent interference from transmitting antennas, the receiving shelter should be located several miles from the transmitting shelter.

b. Interior Requirements. This equipment is designed for operation in a fixed installation. The shelter for fixed installation equipment must meet the following requirements:

(1) Floor ducts must be provided for installation of antenna cables and power cables.

(2) The flooring under the cabinet must be suitable for mounting studs to be used to secure the cabinet. The converter is fitted to be extended on *filing cabinet* type drawer slides (fig. 14) for servicing. In this position, the cabinet becomes somewhat unstable and should be fastened to the floor to prevent tipping and possible injury to operating personnel.

(3) Adequate lighting for day and night operation must be provided. Position the equipment so the panel designations can be easily read. Artificial lighting should be installed so the light falls directly on the front panels of the receiver and converter components. A portable drop lamp and extension cord are convenient assets for maintenance personnel.

(4) Adequate ventilation must be provided for the equipment.

16. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 20.

a. General. Equipment may be shipped in oversea or domestic packing cases. There are five different packages, but the instructions here apply to two—Electrical Equipment Cabinet CY–1119/U and Installation Kit for Radio Receiving Set AN/FRR–38. For instructions pertaining to the receivers and the converter, refer to TM 11–856 and the manual for the converter. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is convenient to the place of permanent or semipermanent installation. The instructions in *b* and *c* below refer to equipment packed in *export packing cases,* and in *f* below to equipment packed in *domestic packing cases.*

Caution: Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged.

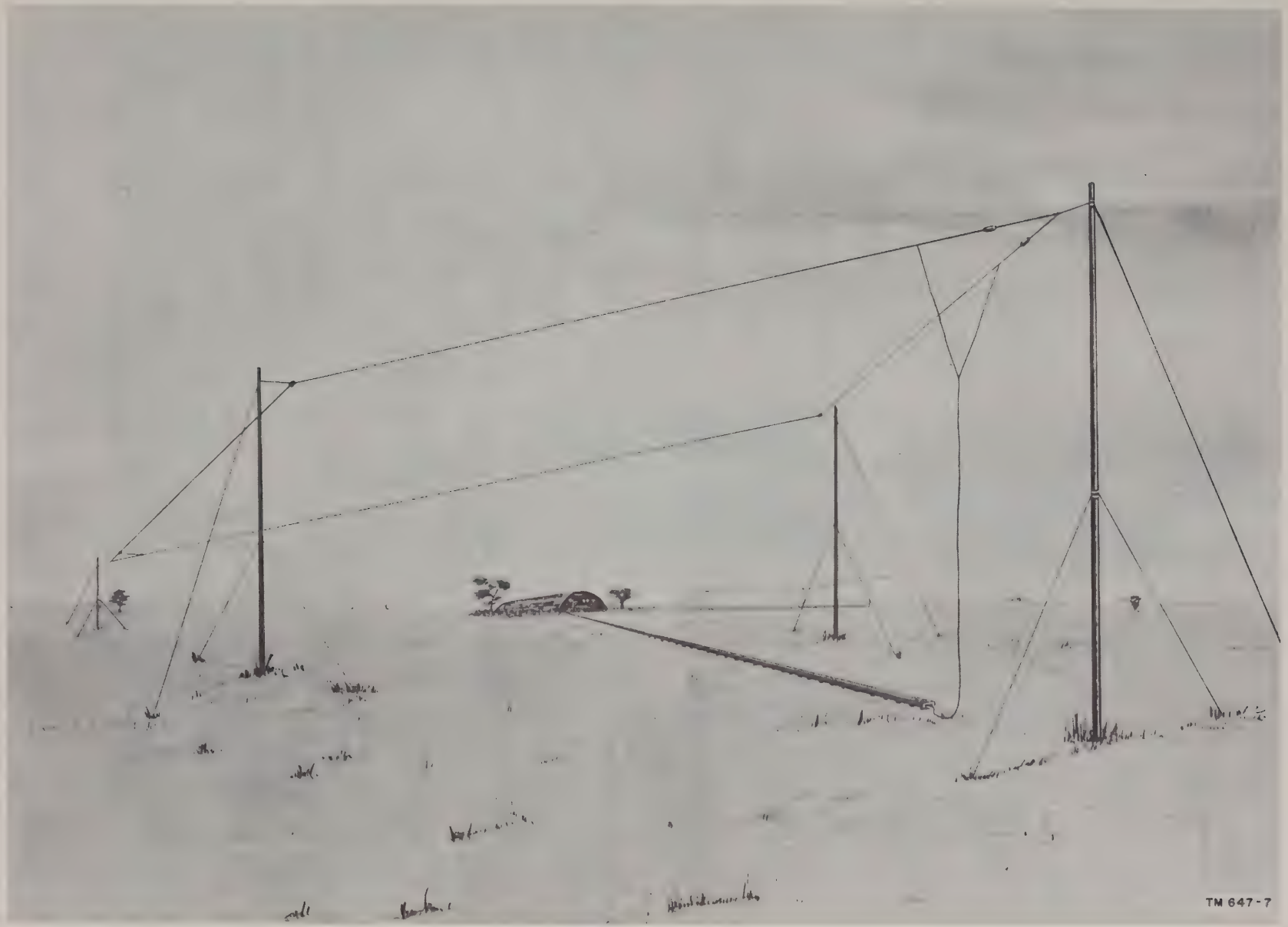

Figure 10. Siting Radio Receiving Set AN/FRR–38.

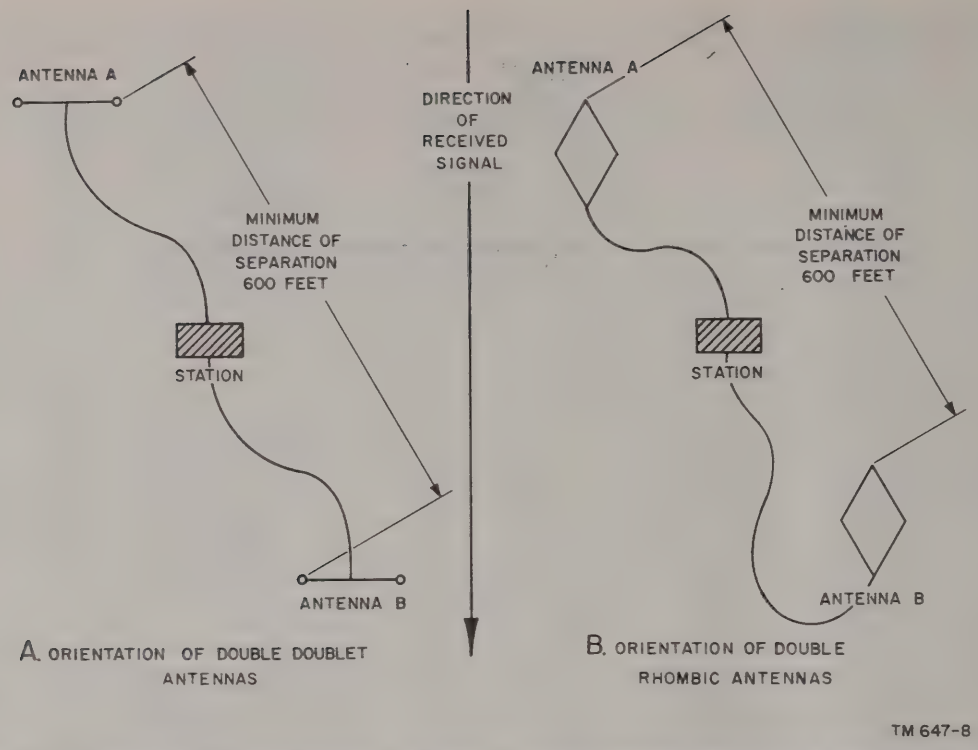

Figure 11. Orientation and positioning of antennas for space diversity reception in typical installation.

b. Step-by-step Instructions for Unpacking Electrical Equipment Cabinet CY–1119/U (fig. 12).

(1) Place the packing case as near the operating position as convenient.
(2) Cut and fold back the steel straps.
(3) Remove the nails from the top with a nail puller and take off the top. Do not attempt to pry off the sides or the ends.
(4) Stand the case on end and slide the fiberboard-covered cabinet out of the case.
(5) With a sharp knife, slit through the fiberboard carton along the edges around the base; lift the carton upward until it is off the cabinet.
(6) Slit through the fiberboard liner along the vertically taped edge; peel the liner away from the cabinet.
(7) Inspect the cabinet for possible damage incurred during shipment.
(8) Check the contents of the packing case against the master packing slip.

c. Step-by-step Instructions for Unpacking Installation Kit for Radio Receiving Set AN/FRR–38 (fig. 13).

(1) Place the packing case as near the operating position as convenient.
(2) Cut and fold back the steel straps.
(3) Remove the nails from the top with a nail puller and take off the top. Do not attempt to pry off the sides.
(4) Open the top of the inner corrugated fiberboard carton and remove the moisture-vaporproof bags. Remove the angle brackets and the blank panels.
(5) Open the moistuer-vaporproof bags; check the contents of the packing case against the master packing slip (*d* and *e* below).

d. Opening Fiberboard Cartons and Moisture-Vaporproof Bags. No special instructions are needed for opening fiberboard cartons and moisture-vaporproof bags or for removing the contents from the fiberboard carton.

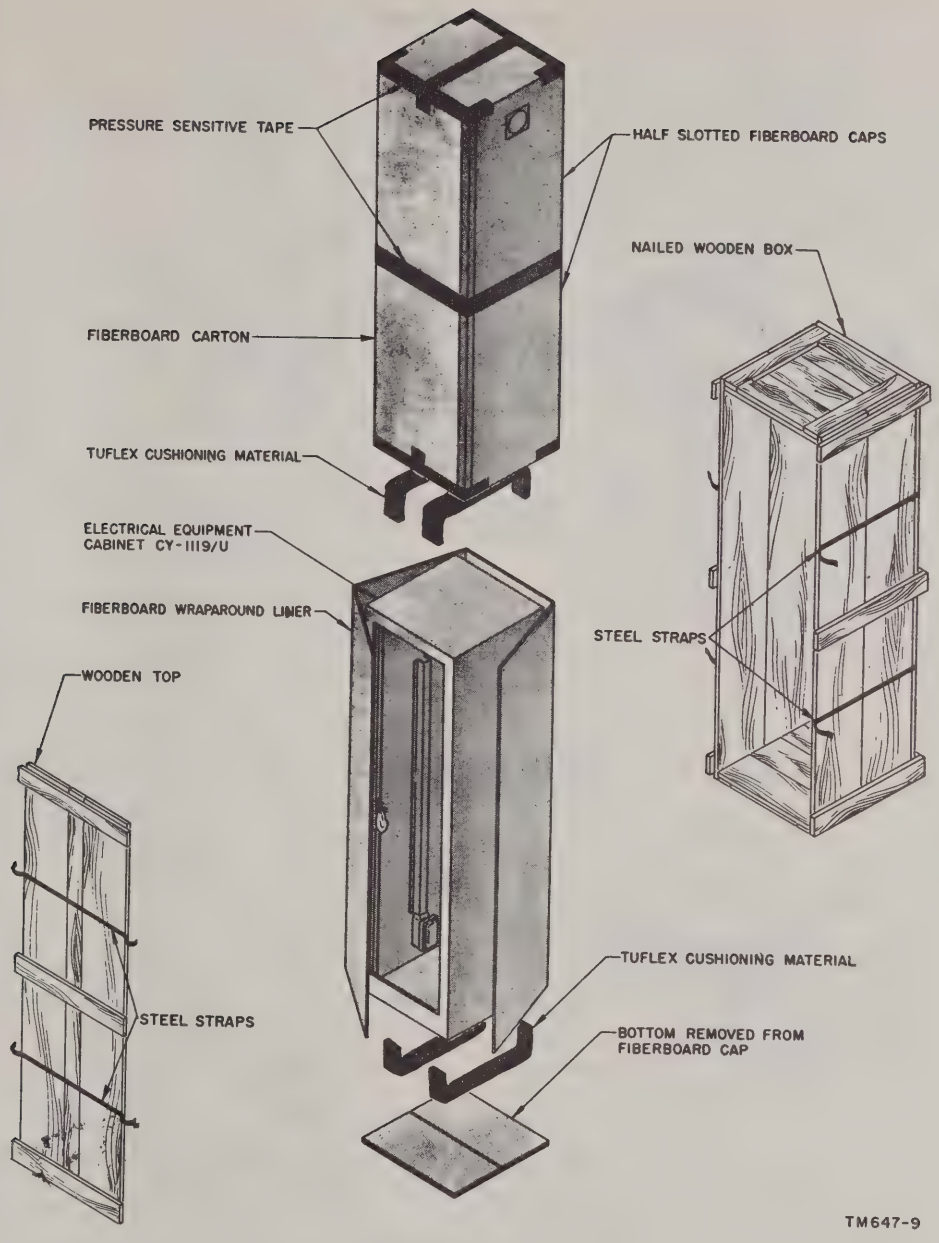

Figure 12. Packing and packaging of Electrical Equipment Cabinet CY–1119/U.

e. Checking. Check the contents against the master packing slip.

f. Unpacking Domestic Packing Cases. Radio equipment may be received in domestic packing cases. The instructions given in *b* and *c* above apply to unpacking domestic shipments also. Cut the steel straps. Open the cartons that protect the equipment and remove the contents. Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

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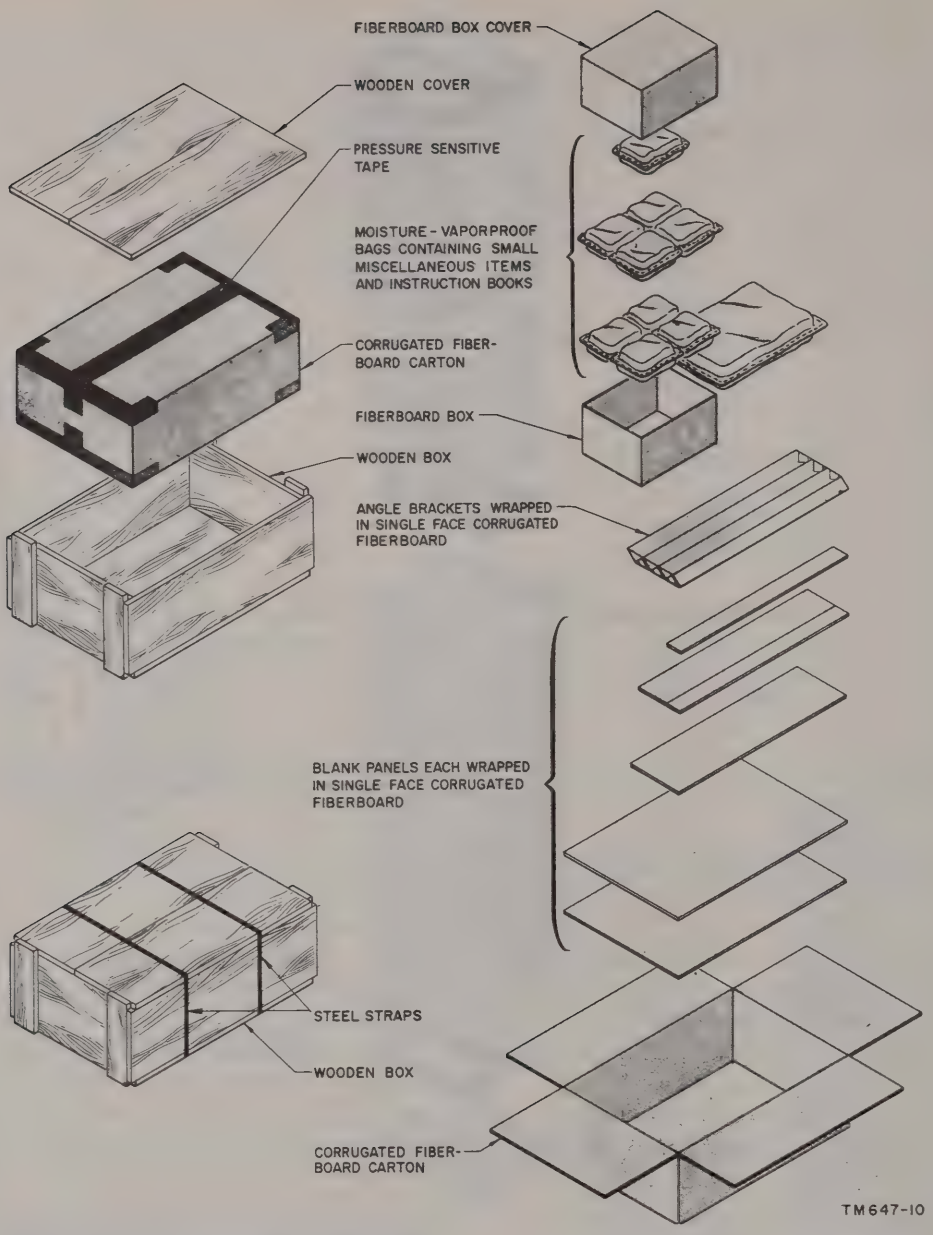


Figure 13. Packing and packaging of Installation Kit for Radio Receiving Set AN/FRR–38.

17. Installation

a. The cabinet interior contains mounting holes to which the angle support brackets (A 1107 through A 1112, fig. 9) may be attached. These holes are arranged in four vertical rows, one row at each corner of the cabinet. To properly install the brackets, proceed as follows:

(1) Count nine mounting holes down from the top of the cabinet in each row. Mount an angle bracket on each side of the cabinet in the *ninth* hole (fig. 19). Fasten the brackets at the front and rear with the bracket mounting hardware that is provided in the installation kit (H1102, H1105, H1106, and H1107, fig. 9).

(2) Mount the brackets firmly, but not so tight that they may not be moved up or down by tapping them lightly with a mallet.

(3) Mount the next set of brackets in the *23d* hole down from the top on each side.

(4) Mount the remaining set in the *37th* hole down from the top on each side.

b. With figure 1 as a guide, fasten the top blank panel, 3½-inches high (A 1106, fig. 9), securely in place with four each of the oval-head screws and cup washers that are provided with the cabinet in a small cloth bag (fig. 8).

c. To facilitate the installation of the converter, remove the chassis-panel assembly from the base assembly by loosening the knob fasteners at each end of the front panel and lifting the chassis-panel assembly up. Then proceed as follows:

(1) Position the base assembly in the cabinet immediately below the blank panel, and fasten it securely in place with eight each of the oval-head screws and cup washers that are provided.

(2) Place the angle brackets flush against the base assembly so that the weight of the assembly is evenly supported. Tap the brackets into position with a soft-headed mallet.

(3) Remove the base assembly from the cabinet and securely tighten the bolts that hold the angle brackets.

(4) Replace the chassis-panel assembly in the base assembly and tighten the two knob fasteners at each end of the front panel.

(5) Before installing the converter, be sure that all tubes and crystal holders are firmly seated in their proper sockets (fig. 15). Check to see that 3-ampere fuses (F1 and F2) are inserted in the fuse holders (fig. 28).

(6) Install the converter in the cabinet and fasten it securely in place with eight each of the oval-head screws and cup washers that are provided.

d. With figure 1 as a guide, fasten a 1¾-inch high blank panel (A 1101, fig. 9) securely in place immediately below the converter with four each of the oval-head screws and cup washers.

e. Position a radio receiver immediately below the 1¾-inch high blank panel, and fasten it securely in place with eight each of the screws and washers. Then proceed as follows:

(1) Place the next set of angle brackets flush against the bottom of the receiver so that the weight of the receiver is evenly supported. Tap the brackets into position with a soft-headed mallet.

(2) Remove the receiver from the cabinet and securely tighten the bolts that hold the angle brackets.

(3) Before installing the receiver, be sure that all tubes and crystal holders are firmly seated in their proper sockets (figs. 16 and 17). Check to see that the proper fuses are inserted in the fuse holders (fig. 26). Check to see that switch S801 (fig. 6) on Power Supply PP–621/URR is in the 115 VAC position. This switch is easily accessible after removing the bottom dust cover of the receiver.

(4) Install the receiver in the cabinet and fasten it securely in place with eight each of the screws and washers.

f. With figure 1 as a guide, fasten a 1¾-inch high blank panel (A 1102, fig. 9) securely in place immediately below the receiver with four each of the screws and washers.

g. Repeat the instructions given in *e* above to install the second receiver.

Note. Before installing the second receiver, check tubes, fuses, and switch S801 (*e*(3) above).

h. With figure 1 as a guide, fasten the two 14-inch panels (A 1103, A 1004, fig. 9) and the 5¼-inch panel (A 1105, fig. 9) securely in place below the second receiver, with a total of 20 of the screws and washers.

Note. Additional equipment may be mounted in the cabinet instead of the three blank panels (*h* above). If additional equipment is used, be sure that adequate fuses and wiring are provided.

i. Fasten the name plate (N 1101), which is provided in the installation kit, to the top front of the cabinet with four of the small slotted binding-head machine screws (2–56 by 3/16 inch). These screws are also provided in the installation kit (H 1101, fig. 9).

j. Fasten the caution plate (N 1102, fig. 9) securely to the top of the rear door of the cabinet with the remaining four slotted binding-head machine screws (2–56 by 3/16 inch) (H 1101, fig. 9).

Caution: To prevent possible injury to personnel, Electrical Equipment Cabinet CY–1119/U must be securely grounded before power is applied.

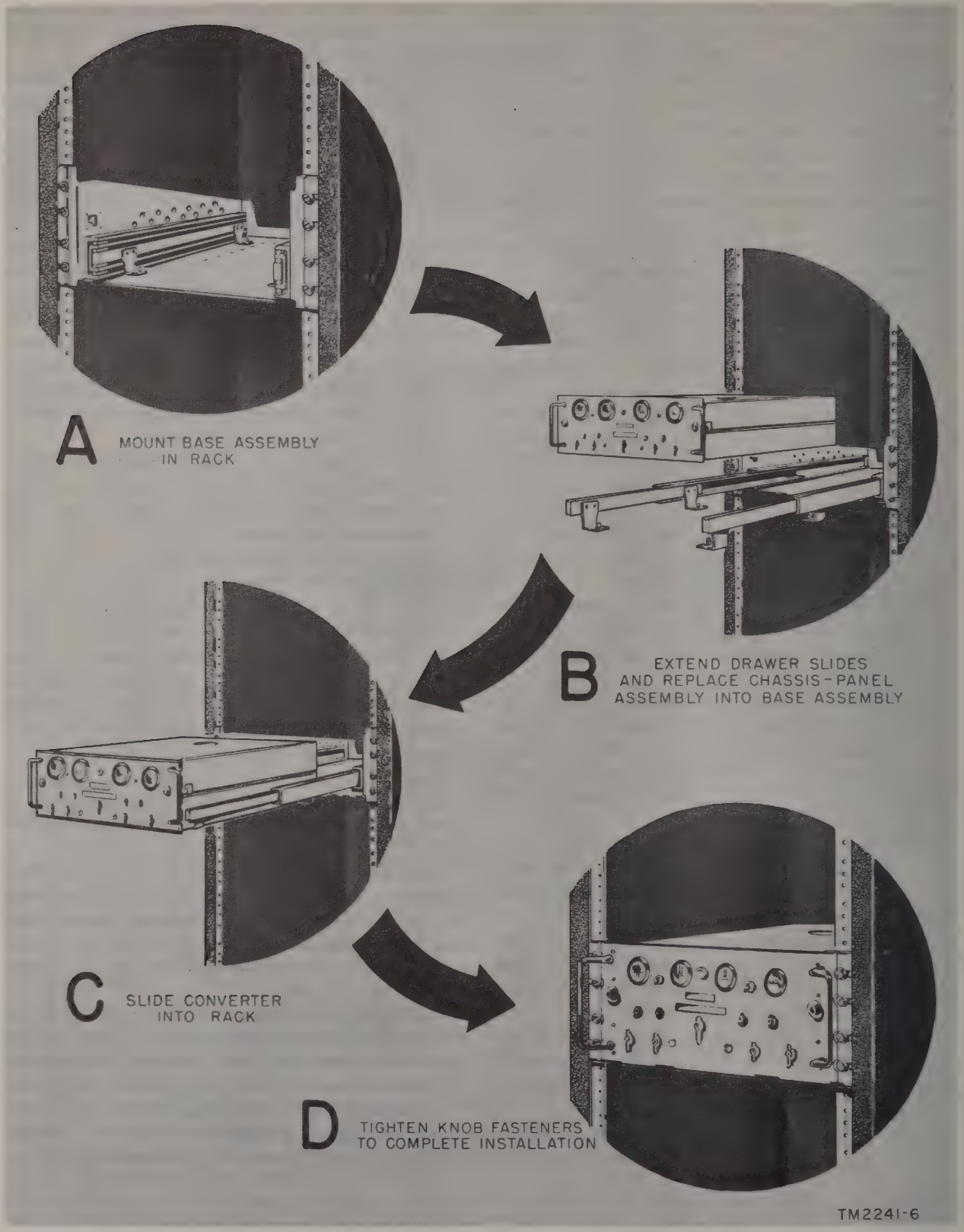


Figure 14. Converter rack mounting details.

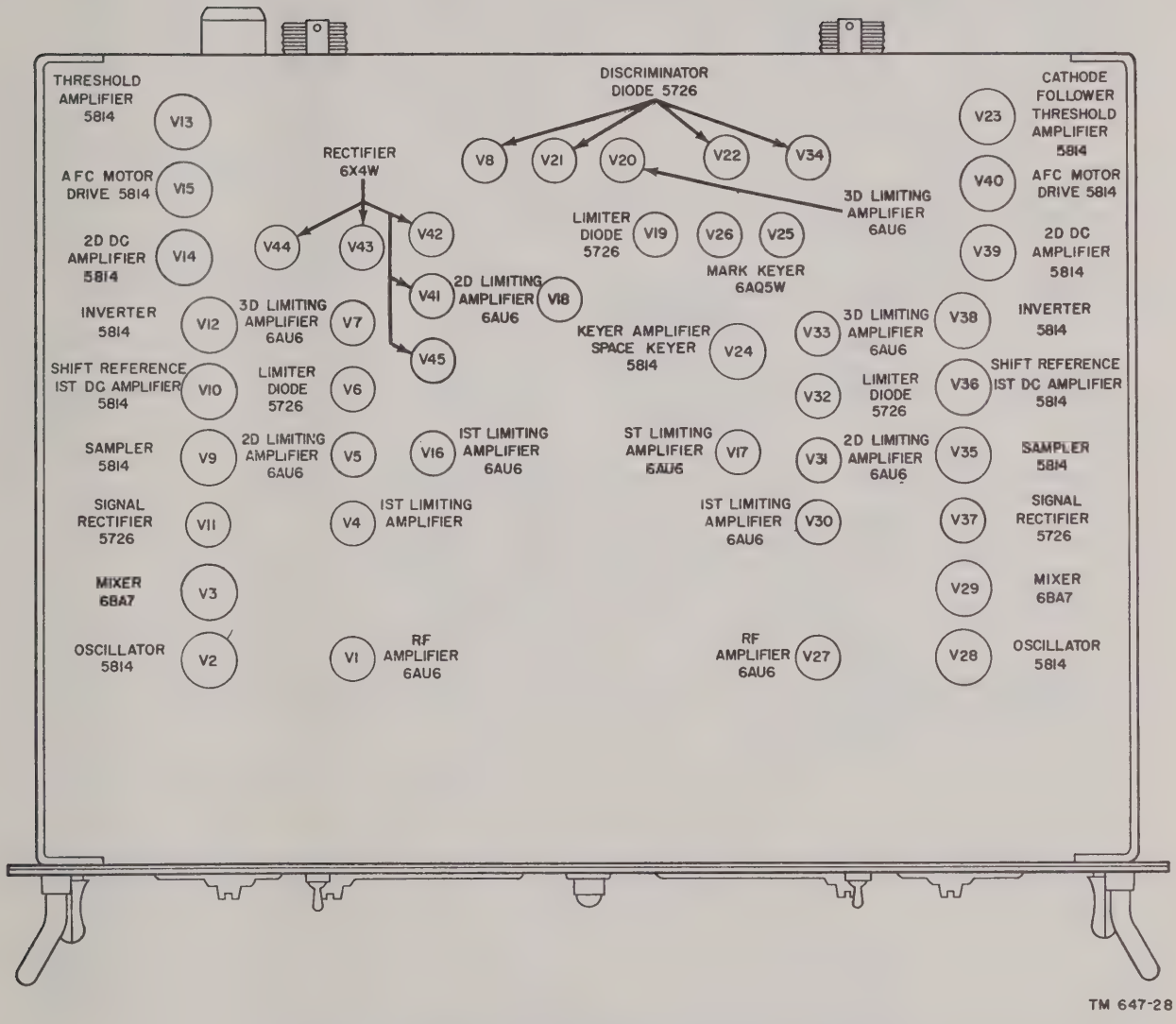


Figure 15. Frequency Shift Converter CV–116/URR, tube locations.

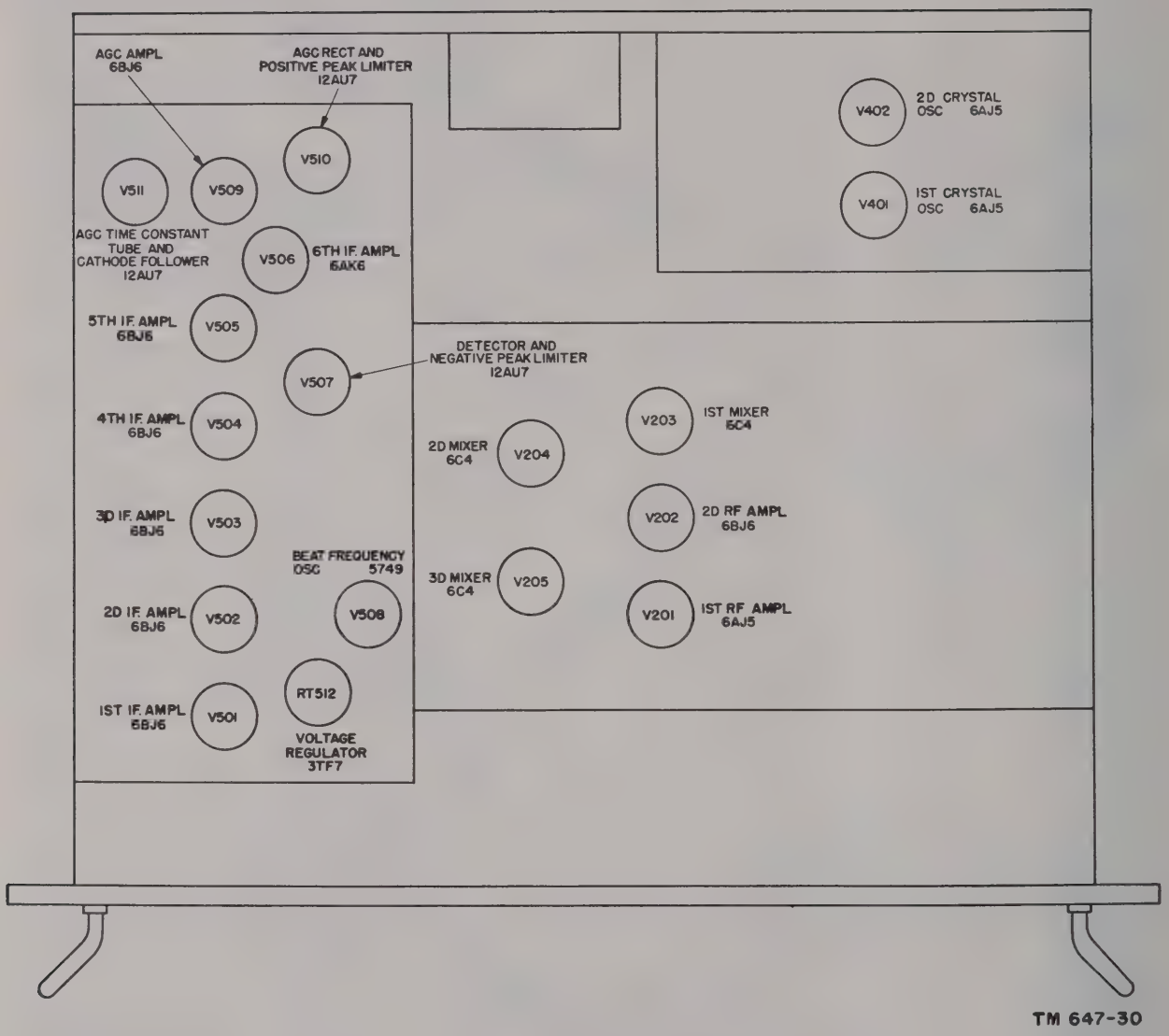


Figure 16. Radio Receiver R-390/URR, top deck, tube locations.

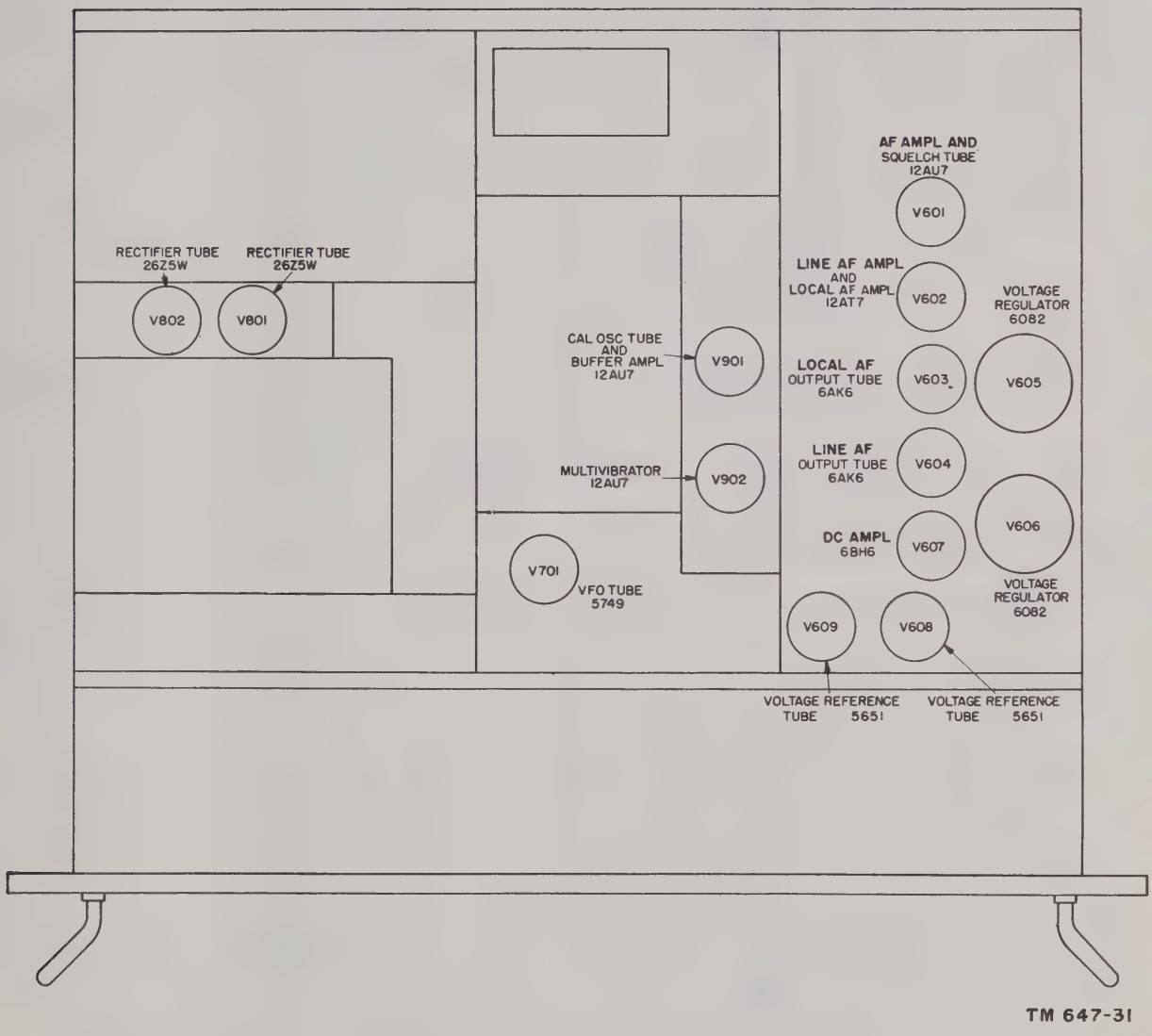


Figure 17. Radio Receiver R-390/URR, bottom deck, tube locations.

18. Connections

Figure 18 is a cording diagram that shows the typical connections between components of the receiving set. When making these connections, dress the connecting cables behind the angle brackets to provide as neat an arrangement as possible. Refer to figure 19 as a guide.

a. Connect Electrical Power Cable Assembly CX–2491/U between the PWR IN connector of the converter and the power receptacle strip of the cabinet.

b. Connect Electrical Power Cable Assembly CX–1358/U (one for each of the receivers) between the POWER (J104) connector of each receiver and the power receptacle strip of the cabinet.

c. Connect Cord CG–409A/U between the INPUT A connector of the converter and the IF OUTPUT 50 OHM (J106) connector of the upper receiver (receiver A).

d. Connect Cord CG–409A/U between the INPUT B connector of the converter and the IF OUTPUT 50 OHM (J106) connector of the lower receiver (receiver B).

e. Two right-angle adapters, Adapter Connector UG–971/U (CP1101, CP1102, fig. 9), and two plugs, Plug Connector UG–573/U (P1101, P1102) are provided in the installation kit. Use them as follows:

(1) Assemble a Plug Connector UG–573/U to each of the antenna lead-in transmission cables (fig. 20).

(2) Connect each Plug Connector UG–573/U to an Adapter Connector UG–971/U.

(3) Refer to figure 18 and connect one antenna lead-in cable to the BALANCED 125 OHM (J108) connector of the upper receiver (receiver A); connect the other antenna lead-in cable to the BALANCED 125 OHM (J108) connector of the lower receiver (receiver B).

Note. The cabinet is equipped with six access openings (two on each side panel and two on the top panel) that provide entrance facilities to the cables from sources outside the cabinet, such as antenna transmission lines, power cables, etc. The cover plates may be removed from the openings by removing the four bolts that hold each cover plate in place.

f. Transfer the shorting jumper from the AGC NOR terminals 3 and 4 on the left terminal strip of each receiver to terminals 4 and 5, then proceed as follows:

(1) Solder a spade lug to each end of a piece of No. 18 AWG or No. 20 AWG hook-up wire, approximately 3 feet long.

(2) Connect one end of the wire to AGC NOR terminal 3 on the left terminal strip of receiver A; connect the other end to AGC NOR terminal 3 on the left terminal strip of receiver B (fig. 19).

g. Connect the cable from the teletypewriter or control unit to the TT connector of the converter. Pins A and D of the TT connector provide output from the converter to the teletypewriter loop supply. Refer to the technical manual of the teletypewriter for connections to it. Pins C and B of the TT connector provide the means for remotely placing the converter output in a mark-hold condition. This remote control connection may be made by wiring a switch between the two cable conductors that lead from pins C and B of the TT connector plug.

h. Connections may be made, with UG–88/U connectors (fig. 21) at the OUTPUT A and OUTPUT B connectors, from the converter discriminator circuits to specialized tuning indicators, if provided.

i. For power input to the receiving set use a size 14 cable or larger. If additional equipment is installed in the cabinet, the power cable and fuses must be adequate to maintain the load. Connect the cable from the power source to the switch box in the cabinet as follows:

(1) The switch box within the cabinet (fig. 22) is provided with knockout panels that may be removed, if necessary, to provide entrance to the box for the power cable. Determine which entrance is to be used, and remove the knockout panel by placing the point of a punch in the center of the panel and tapping the punch with a hammer.

(2) Solder a spade type lug to the end of each conductor of the power cable.

(3) Connect the cable leads to the switch box line connection terminals (fig. 22). Tighten the screws firmly on the lugs to assure good electrical contact.

j. Insert two fuses, which are provided in the installation kit (F1101, F1102, fig. 9), into the

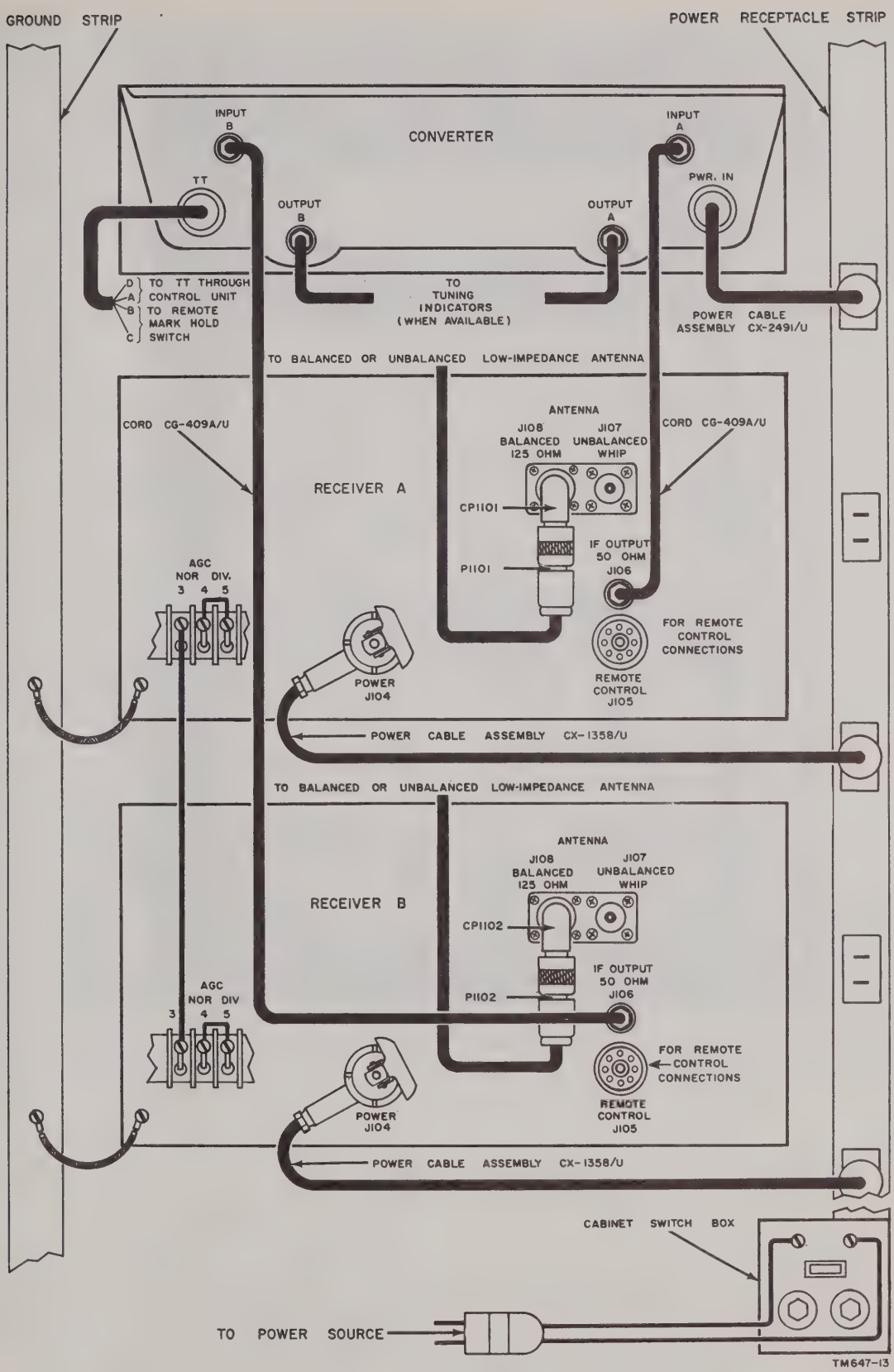


Figure 18. Radio Receiving Set AN/FRR-38, cording diagram.

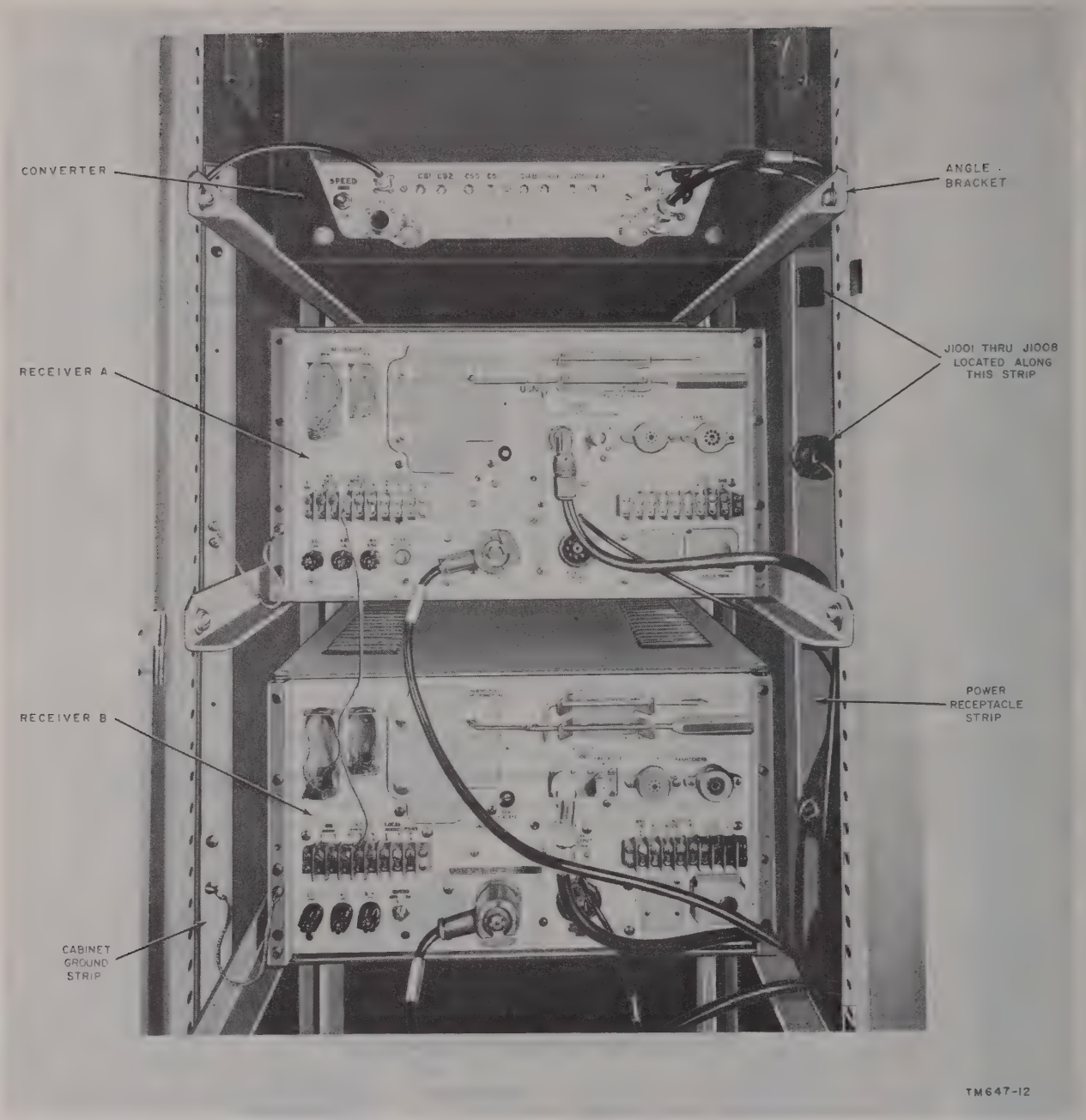
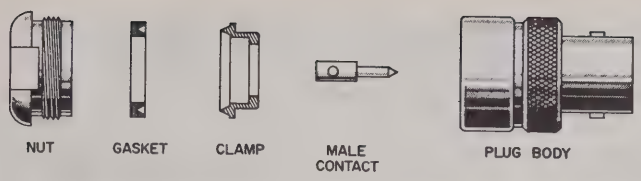
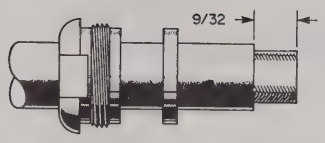
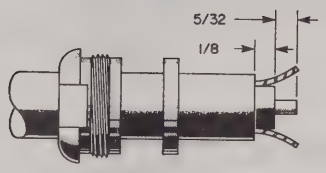


Figure 19. Radio Receiving Set AN/FRR–38, typical installation, rear view.



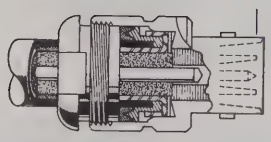


PLACE NUT AND GASKET OVER CABLE AND CUT OFF JACKET TO A DISTANCE OF 9/32 INCH.



COMB BRAID WIRES THOROUGHLY AND FOLD OUT. CUT OFF CABLE DIELECTRIC TO A DISTANCE OF 5/32 INCH LEAVING 1/8 INCH PROTRUDING FROM JACKET.

PULL BRAID WIRES FORWARD AND TAPER TOWARD CENTER CONDUCTOR. PLACE CLAMP OVER BRAID AND PUSH BACK AGAINST CABLE JACKET. FOLD BACK BRAID WIRES, TRIM TO PROPER LENGTH, AND FORM OVER CLAMP. SOLDER CONTACT TO CENTER CONDUCTOR WITH A MINIMUM AMOUNT OF SOLDER. REMOVE ALL EXCESS SOLDER.



INSERT CABLE INTO PLUG BODY. MAKE SURE SHARP EDGE OF CLAMP IS PROPERLY SEATED IN GROOVE OF GASKET. ROTATE NUT INTO PLUG BODY UNTIL SUFFICIENT PRESSURE IS APPLIED TO SPLIT GASKET AND INSURE GOOD CONTACT BETWEEN NUT AND CLAMP.

NOTE: END OF MALE CONTACT IS FLUSH WITH INSULATOR END AS SHOWN. END OF FEMALE CONTACT IS .010 INCH BELOW END OF INSULATOR.

TM 647-14

Figure 20. Plug Connector UG–573/U, assembling instructions.

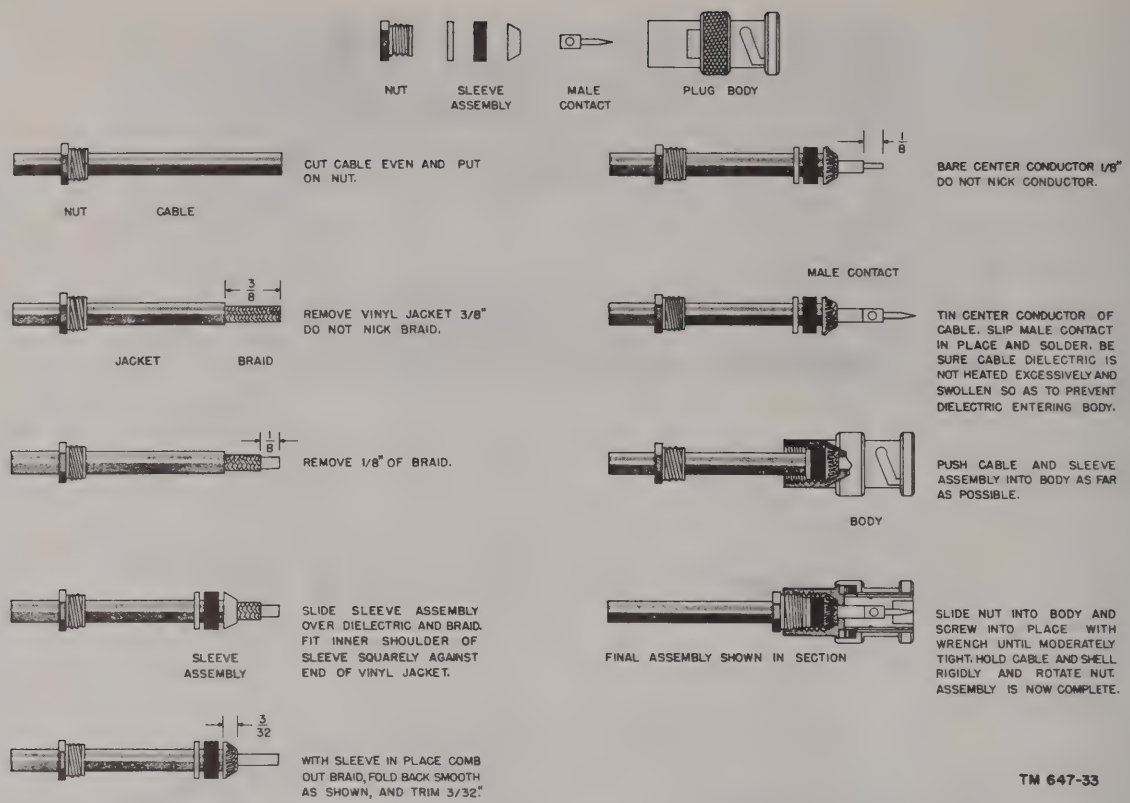


Figure 21. Plug Connector UG–88/U, assembling instructions.

fuse sockets as shown in figure 22. Do not screw them in so tightly that removing a blown fuse will be difficult.

Caution: Fuses F1101 and F1102, which are provided in the installation kit for mounting in the cabinet switch box, are 10-ampere fuses. Fuses of higher rating are necessary if additional equipment is installed in the cabinet.

k. Install two ground straps (W1101 and W1102, fig. 9) from the cabinet ground strip to the receivers. Use two 10–32 slotted binding-head screws (H1103, fig. 9) to fasten the ends at the ground strip, and two 6–32 slotted binding-head screws (H1104, fig. 9) to fasten the ends at the receivers (fig. 18). The screws and ground straps are provided in the installation kit. Figure 19 shows a typical installation.

19. Choosing an Antenna

Radio Receiver R–390/URR is so sensitive and selective that it will operate satisfactorily, under most conditions, with a simple long wire or whip antenna. For more dependable operation over great distances, however, use more efficient

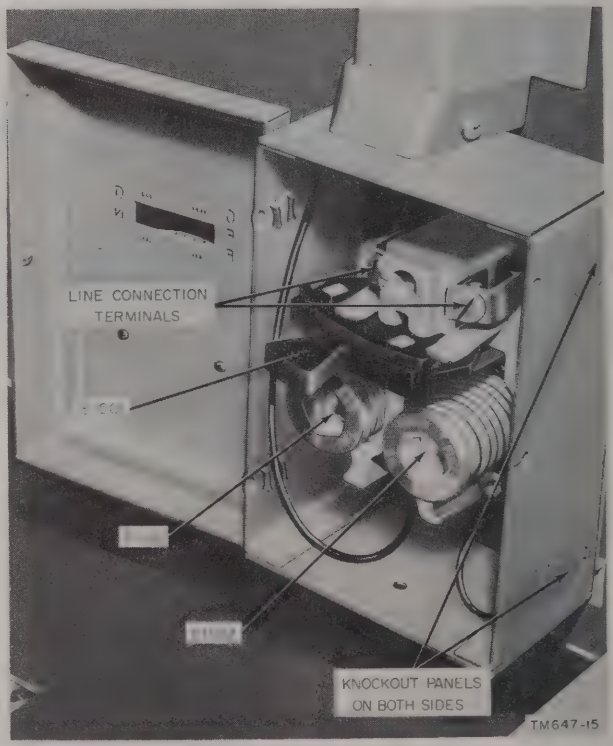


Figure 22. Switch box in Electrical Equipment Cabine CY–1119/U.

antennas in permanent or semipermanent types of installations.

a. Double-Doublet Antenna (fig. 23). The double-doublet antenna is regarded as a general purpose broad-band antenna that is suitable for reception in any direction except possibly off the ends. Detailed installation instructions for a double-doublet antenna are given in TM 11–2629.

b. Rhombic Antenna (fig. 24). The rhombic is the type of receiving antenna most commonly used for operation over great distances between permanent installations. This type of antenna has very good broad-band characteristics, and is much more directional than the double-doublet type (*a* above). Detailed instructions for erecting and dimensioning rhombic receiving antennas for various operating distances are given in TM 11–2611.

20. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 16 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications that pertain to changes in the equipment wiring. If any changes in the wiring have been made, make the change in this technical manual, preferably on the schematic diagrams.

c. Check the operating controls for ease of rotation. If lubrication is required, refer to the lubrication instructions in paragraphs 46 and 47.

d. Perform the installation and connection procedures given in paragraphs 17 and 18.

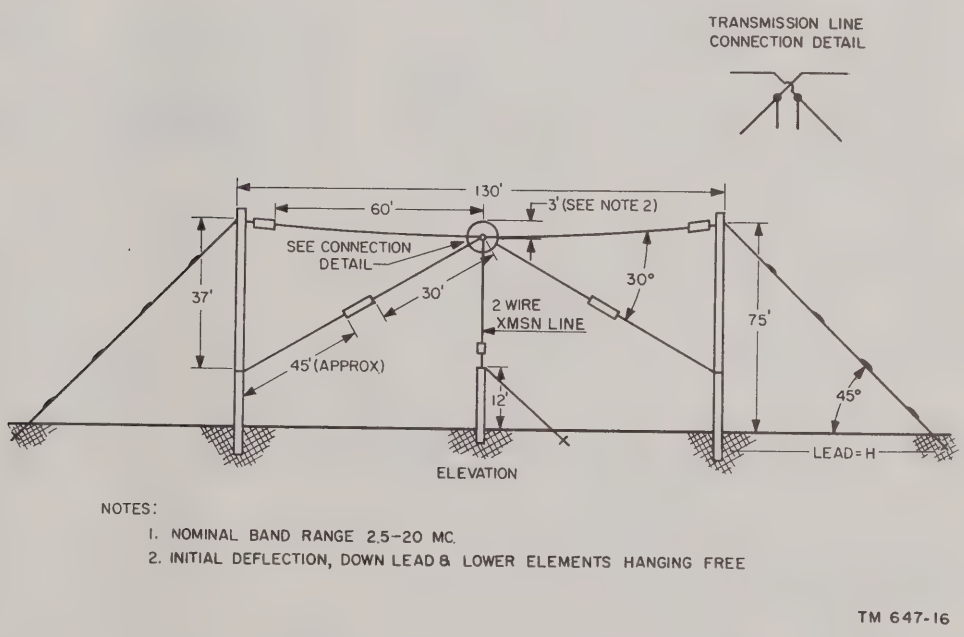
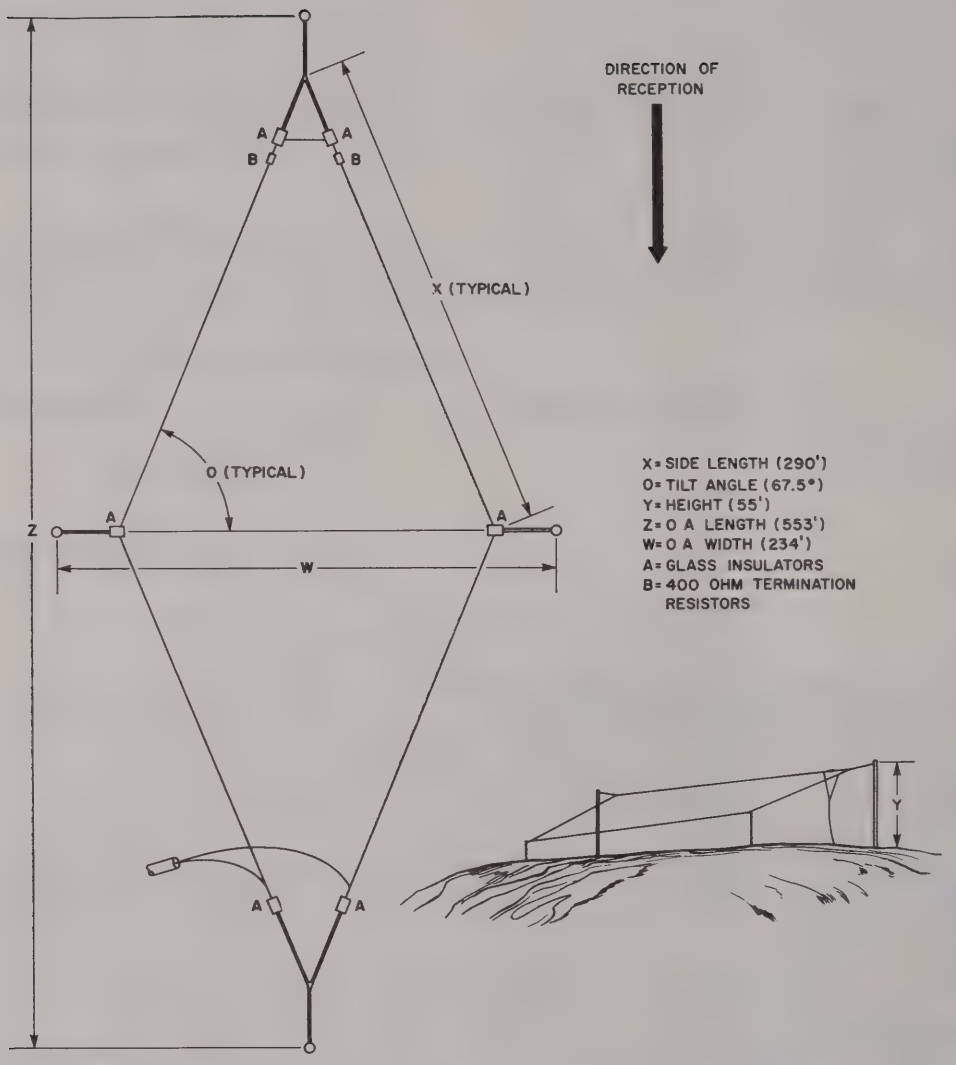


Figure 23. Double-doublet antenna for use between 2.5 and 20 mc.



NOTES:

1 FEED EACH CONDUCTOR OF BALANCED LINE FROM ONE SIDE OF ANTENNA
2 TERMINATION RESISTORS SHOULD BE NON REACTIVE
3 SINGLE TERMINATION RESISTOR (800 OHM) IS SATISFACTORY
4 WITHOUT TERMINATION RESISTORS, ANTENNA WILL BE BI-DIRECTIONAL ALONG ITS LONGEST DIMENSION

TM 647-17

Figure 24. Rhombic antenna.

21. General

Haphazard operation or improper setting of the controls may cause damage to electronic equipment. Therefore, it is important to know the function of every control. The actual equipment operation is discussed in the next section of this manual.

22. Radio Receiver R–390/URR, Controls and Indicating Instruments

(figs. 25 and 26)

The controls of the receiver and their functions are listed in the following table:

Control	Function
LINE METER OFF-ON and range switch (S101)	In OFF position, disconnects LINE LEVEL meter from balanced-line output. In +10 position, 10 decibels (db) is to be added to LINE LEVEL volume units (vu) reading; in 0 position, LINE LEVEL meter is read directly in vu; in −10 position, 10 db is to be subtracted from LINE LEVEL vu reading.
LINE GAIN control (R103)	Controls level of audio frequency signal applied to balanced-line output terminals.
AGC SLOW-MED.-FAST time constant switch	Determines rapidity of change in gain of receiver for certain change of signal strength.
LIMITER OFF-ON switch and threshold control (S105 and R124).	When turned on, peak signal impulses are cut off to reduce static interference. Further reduction of signal peaks is obtained at clockwise positions of control.
BANDWIDTH switch (S501)	Selects width of pass band in KC for 455 kc if amplifier stages.
BFO PITCH control (Z502)	Varies frequency of beat-frequency oscillator.
AUDIO RESPONSE switch (S102)	Varies response of audio amplifier. In SHARP position, 800 cps low-pass filter is inserted into audio circuit; in MED position, 3,500 cps low-pass filter is inserted; in WIDE position, no filter is used.
BREAK IN OFF-ON switch (S106)	In ON position, break-in relay control circuit is connected to REMOTE CONTROL receptacle J105, and balanced-line output is disconnected from J105.
FUNCTION switch (S107)	When rotated to any position besides OFF, connects receiver to power source and selects desired receiver function. The positions and functions follow: *Position* — *Function* STAND BY — Receiver disabled but filaments remain lighted and oscillators remain on; receiver ready for instant use. AGC — Gain is controlled automatically for normal reception. MGC — AGC disabled; gain is controlled manually by RF GAIN control or an external gain control. CAL — Calibration oscillator enabled to supply signals at 100 kc points. SQUELCH — Squelch circuit is connected for silencing receiver when input signal falls below threshold determined by setting of RF GAIN control.
ANT TRIM	Enables tuning out reactive component of the antenna.
BFO OFF-ON switch (S103)	In ON position, places bfo in operation.
DIAL LOCK	Locks KILOCYCLE CHANGE control to prevent accidental change of setting.
ZERO ADJ	When tuned clockwise, disengages frequency indicator from KILOCYCLE CHANGE control for calibration.
LOCAL GAIN control (R104)	Controls level of af signal applied to local output terminals.

Control	Function
RF GAIN control (R123)	Controls gain of radio frequency (rf) and if amplifiers. When squelch circuit is operative, controls squelch threshold and permits maximum automatic gain control (agc) when in maximum clockwise position.
KILOCYCLE CHANGE control	Tunes receiver to any frequency within band, and changes reading of last three digits on frequency indicator. Frequency range of control slightly greater than 1 mc; when tuned to frequency higher or lower than that indicated by first two digits, plus or minus sign is displayed in space between mc and kc readings indicating, respectively, addition or subtraction of 1 mc in reading of first two digits to obtain true reading.
MEGACYCLE CHANGE control	Selects any one of 32 tuning steps; changes reading of first two digits of frequency indicator.
LINE LEVEL meter (M101)	Indicates level of balanced-line output.
CARRIER LEVEL meter (M102)	Indicates level of incoming rf signal. Indication of 0 db when RF GAIN control is fully on, corresponds to an input signal of 2 to 5 microvolts.
OVENS OFF-ON switch	Screwdriver adjustment. In ON position, 26 volts ac are applied to frequency oscillator crystal oven HR401 and vfo oven HR701.

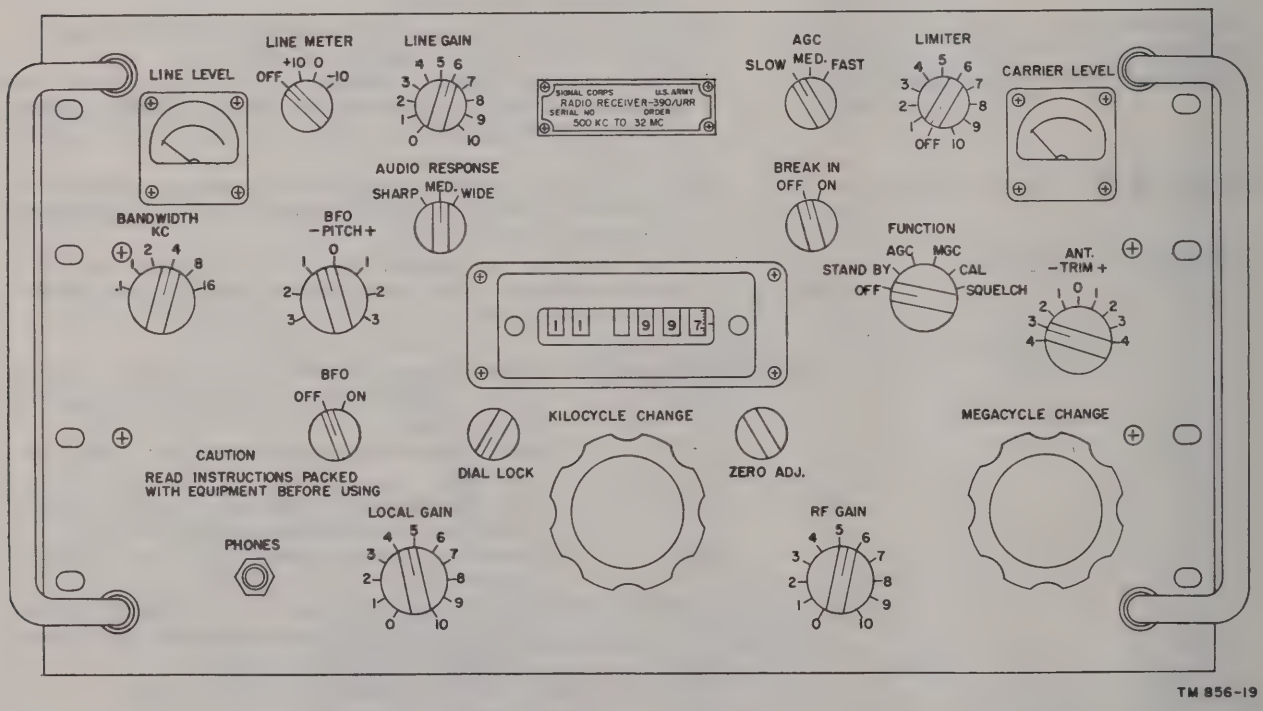
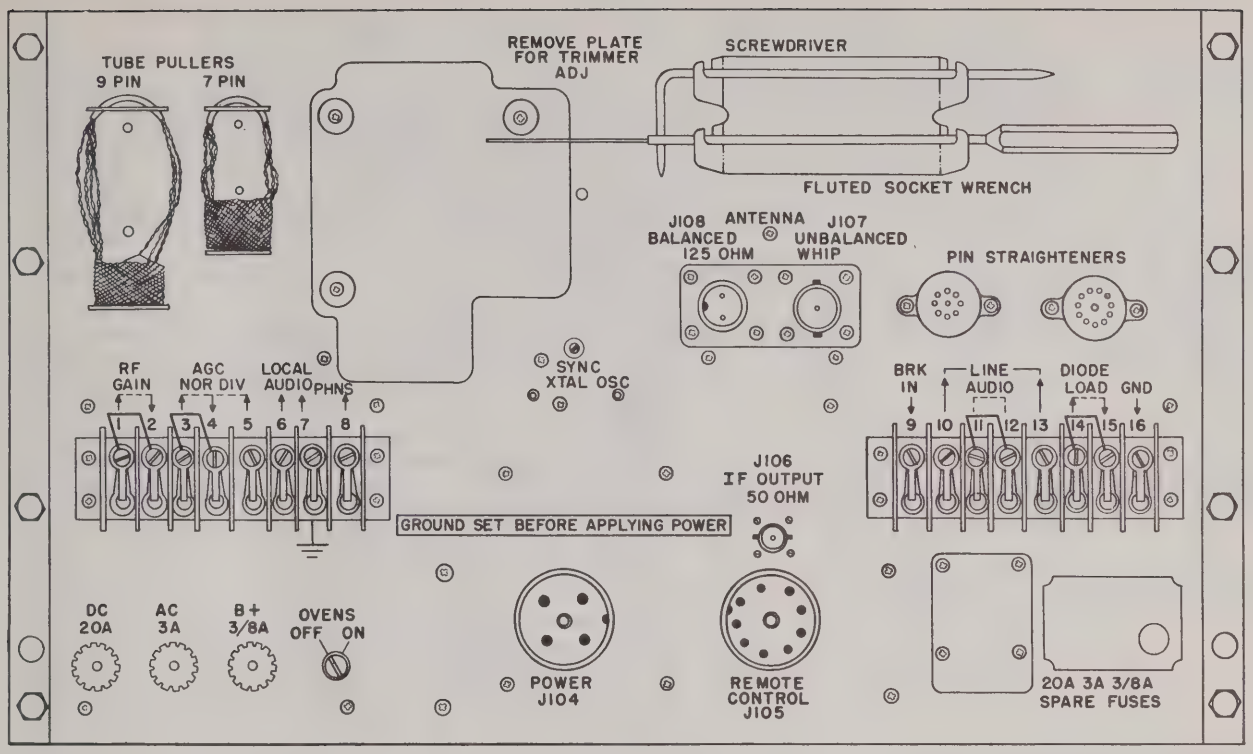


Figure 25. Radio Receiver R-390/URR, front panel.



TM 856-18

Figure 26. Radio Receiver R-390/URR, rear panel.

23. Frequency Shift Converter CV-116/URR Controls and Indicating Instruments

(figs. 27, 28, and 29)

The controls of the converter and their functions are listed in the following table:

Control	Function
POWER ON-OFF switch (S9)	In ON position, connects converter to alternating current power source.
AFC ON-OFF	In ON position, puts automatic frequency control (afc) into operation. Loss of output or distortion in output tty signals, because of drift of received signals, is thereby minimized.
CHANNEL SELECTOR switch (S5)	Selects channel or channels to be fed to diversity circuits. When operating with single channel input, second channel input is disabled.
CHANNEL A AFC SHIFT ADJUSTMENT (R41).	Adjusts balance of channel A afc dc amplifiers for signals of various frequency shifts.
CHANNEL A AFC THRESHOLD LEVEL (R50 and S3).	Determines minimum level above which channel A automatic frequency control circuit and keyer will operate. In OFF position, ganged switch S3 is opened allowing keyer to operate at minimum signal levels. At maximum clockwise position automatic frequency control capacitor-tuning motor circuits are made inoperative and keyer circuit is placed in mark-hold condition regardless of signal levels.
CHANNEL A MARK HOLD-XTAL-AFC switch (S1).	Selects method of frequency control for channel A oscillator V2, and energizes mark-hold circuit for test purposes. Right or left setting determines polarity of output mark-space signals.

Control	Function
CHANNEL A DRIFT INDICATOR (C8)	Indicates amount of correction from original setting automatically applied to channel A oscillator circuit to compensate for signal drift when operating MARK HOLD-XTAL-AFC switch in AFC position and AFC ON-OFF switch in ON position. Clutch permits manual control and correction of channel A oscillator frequency when operating MARK HOLD-XTAL-AFC switch in AFC position.
CHANNEL B AFC SHIFT ADJUSTMENT (R151).	Adjusts balance of channel B afc dc amplifiers for signals of various frequency shifts.
CHANNEL B AFC THRESHOLD LEVEL (R161 and S8).	Determines the minimum level above which the channel B afc circuit and keyer will operate. In the OFF position, ganged switch S8 is opened allowing the keyer to operate at minimum signal levels. At maximum clockwise position the afc capacitor-tuning motor circuits are made inoperative and the keyer circuit is placed in a mark-hold condition regardless of signal levels.
CHANNEL B MARK HOLD-XTAL-AFC switch (S7).	Selects method of frequency control for channel B oscillator V28 and also to energize the mark-hold circuit for test and/or tuning purposes. Using the right or left setting determines polarity of output mark-space signals.
CHANNEL B DRIFT INDICATOR (C60)	Indicates amount of correction from original setting automatically applied to channel B oscillator circuit to compensate for signal drift when operating MARK HOLD-XTAL-AFC switch in AFC position and AFC ON-OFF switch in ON position. Clutch permits manual control and correction of channel B oscillator frequency when operating MARK HOOD-XTAL-AFC switch in AFC position.
SPEED HIGH-LOW switch (S12)	Placed in HIGH position for keying speeds over 60 dot cps; placed in LOW position for keying speeds under 60 dot cps. For the reception of time division multiplexed signals, this switch is normally in the HIGH position.
CHANNEL A DISCRIMINATOR meter (M4)	Shows character of output from channel A discriminator. Is used in conjunction with S11 and S10 for testing various internal circuits of converter.
CHANNEL A SIGNAL INPUT meter (M1)	Indicates signal input level to converter delivered from receiver A.
CHANNEL B DISCRIMINATOR meter (M3)	Shows character of output from channel B discriminator.
CHANNEL B SIGNAL INPUT meter (M2)	Indicates input signal level to converter delivered from receiver B.
PRESS-TO-TEST switch (S10)	In the normal (out) position, connects meter M4 to the output of Z2; in the depressed position, connects meter M4 to switch S11.
Meter switch (S11)	Has 12 positions, 3 of which are unused. The positions are as follows: 1. *R109*. When S10 is depressed, meter M4 indicates loop current through mark keyer tubes V25 and V26. This position is used when the output circuit of the converter is matched to the TT loop supply (par. 25). 2. Unused. Remaining positions of S11, listed at left, are 3. Unused. used in alinement and adjustment procedures 4. *R57*. for Frequency Shift Converter CV–116/URR. 5. *R167*. Their proper use is explained in the converter 6. *A*+*B*. manual. 7. Unused. 8. *B*+. 9. *B*−. 10. *R94*. 11. *R99*. 12. *R104*.

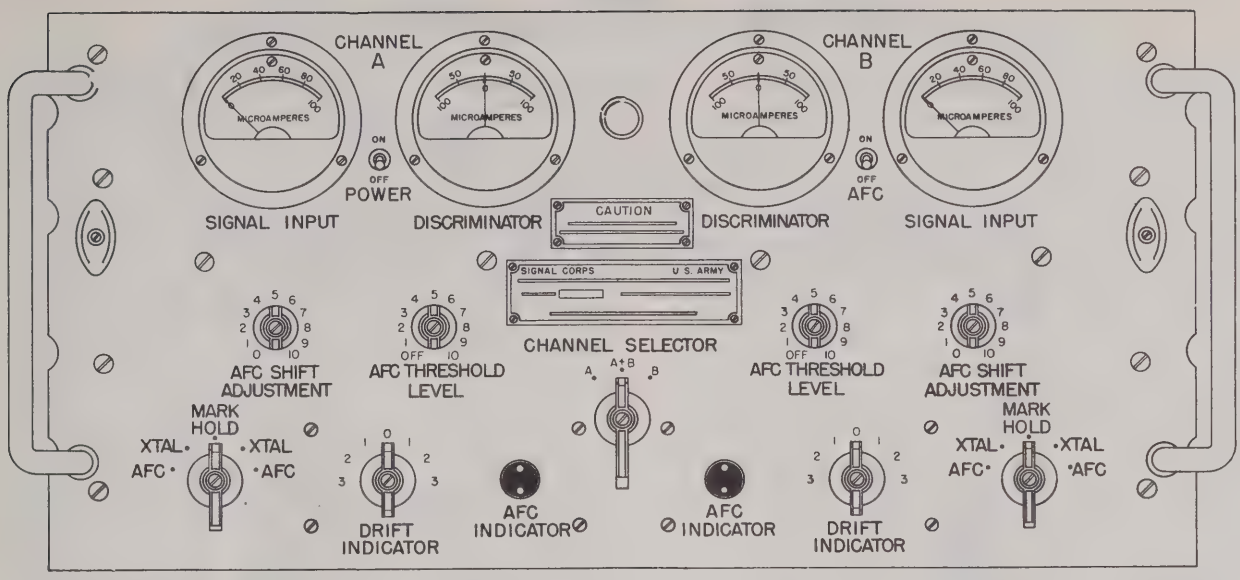


Figure 27. Frequency Shift Converter CV–116/URR, front panel.

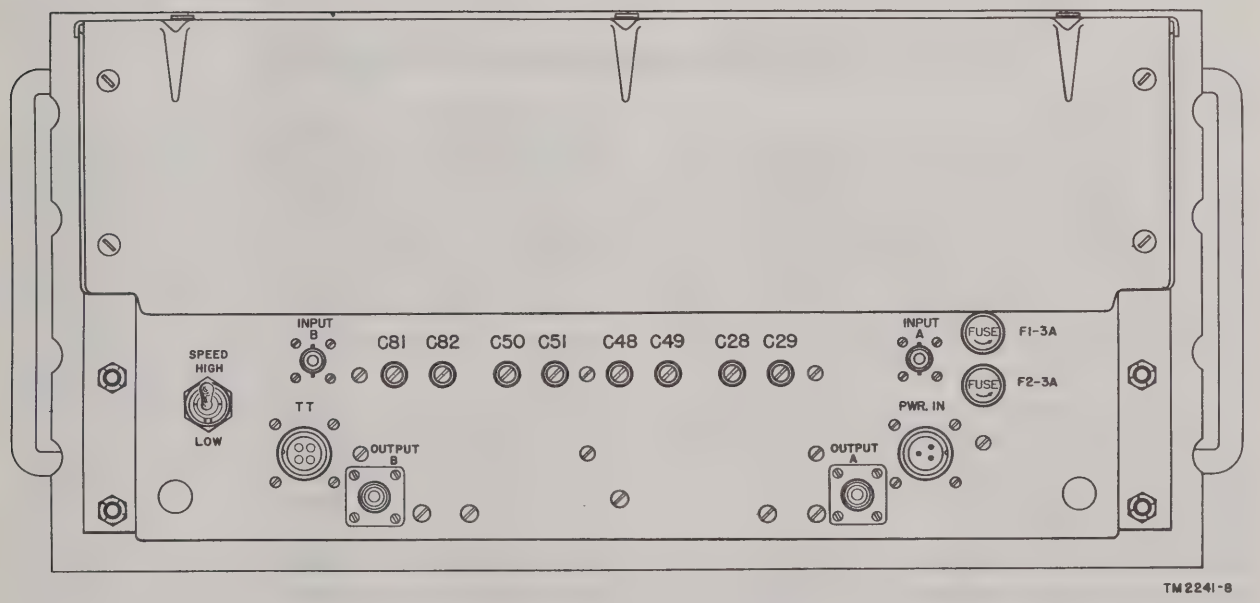


Figure 28. Frequency Shift Converter CV–116/URR, rear panel.

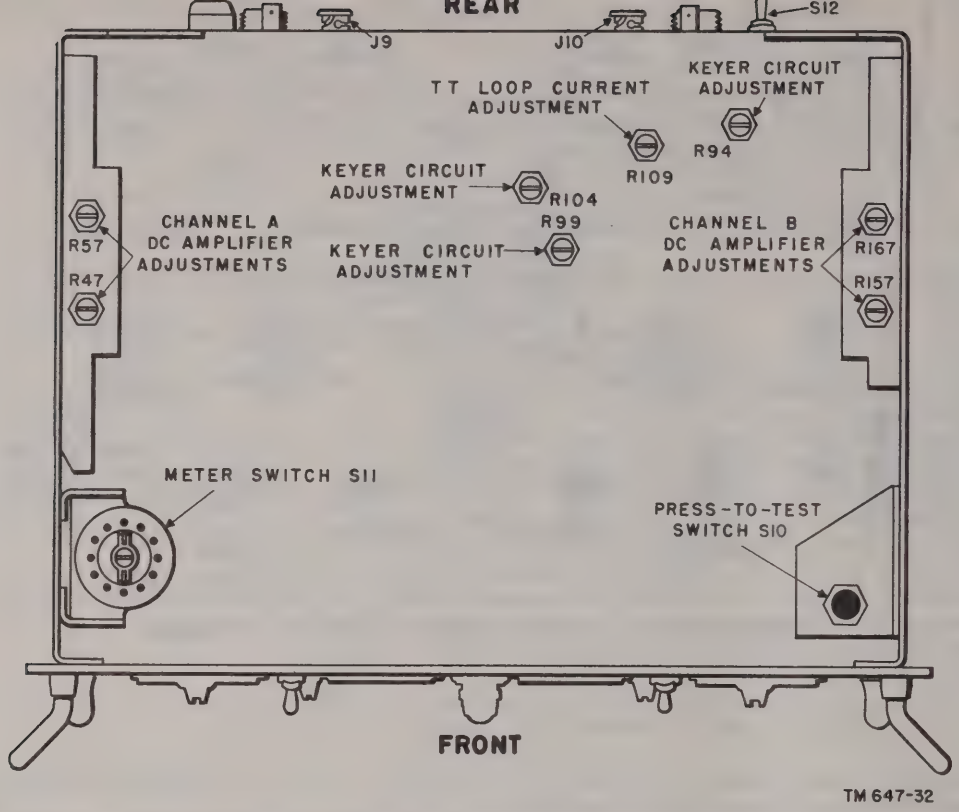


Figure 29. Frequency Shift Converter CV–116/URR, afc and keyer circuit adjustment and metering switches.

Section III. PRESETTING AND INITIAL ADJUSTMENT

24. Presetting

If the equipment is operated under low temperature conditions or in a location that is subject to variations in temperature, set the screwdriver adjusted OVENS ON-OFF switch on the back panel of both receivers to ON. When operating the equipment in a temperature-regulated building, set the OVEN ON-OFF switch to OFF.

Caution: The ac power supply of both receivers in the equipment must be set to operate at 115 VAC (par. 17*e*(3)).

25. Initial Adjustments

a. General. In teletypewriter-printer loop circuits, a marking current of 60 milliamperes is used. Potentiometer adjustment R109 on the converter (fig. 29) maintains the proper current flow for external loop resistance variations between 125 and 500 ohms. Once set for a given loop circuit, frequent adjustments of the output circuit should not be necessary. However, the initial adjustment is required whenever a different printer is used, whenever changes are made in the external loop circuit to compensate for component aging, or whenever slightly different ac power conditions may exist.

b. Electrical Equipment Cabinet. Set the FUNCTION switch on both receivers to the OFF position. Set the POWER switch on the converter to the OFF position. Set the line switch in the switch box (fig. 8) at the bottom of the cabinet to the ON position.

c. Loop Current Adjustment. After checking to see that all required connections have been made as described in paragraph 18, throw the converter POWER switch to the ON position. The pilot lamp should light. Set the converter meter switch S11 (fig. 29) to position R109. Depress the PRESS-TO-TEST switch (fig. 29) and adjust potentiometer R109 for a 60-microampere reading on the CHANNEL A DISCRIMINATOR meter (M4). This reading, multiplied by 100, is 60 milliamperes, the required loop current.

26. General

Instructions are given in this and the next sections for operations in which the receiver and converter components of Radio Receiving Set AN/FRR–38 are used together. For instruction using Radio Receiver R–390/URR for receiving other than frequency shift signals, or instructions for using Frequency Shift Converter CV–116/URR with other receivers, refer to TM 11–856 and the converter manual.

27. Diversity Operation

The following operational procedure applies to the equipment when it is being used to receive either space or frequency diversity radio telegraph signals. The designations *receiver A* and *receiver B* used throughout the material refer, respectively, to the upper and lower receivers mounted in the cabinet when connected as shown in figure 18.

a. Receiver Controls. Set the FUNCTION switch to AGC, the BFO to ON, the BFO PITCH control to 0, the LINE GAIN to 0, the RF GAIN to 10, the AGC time constant to MED, the LOCAL GAIN to 5, the BANDWIDTH to 4 KC, the AUDIO RESPONSE switch to MED, the LIMITER to OFF and disengage the DIAL LOCK control. Set the controls of both receiver A and receiver B in this manner.

b. Converter Controls. Set the POWER switch to ON, the AFC switch to OFF, both AFC SHIFT ADJUSTMENT controls to 0, the AFC THRESHOLD LEVEL controls to OFF, the CHANNEL SELECTOR switch to A, both AFC-XTAL-MARK HOLD switches to MARK HOLD, and the DRIFT INDICATOR controls to 0.

c. Warmup. Allow a few minutes for the equipment to warm up.

d. Tuning the Receivers.

(1) With the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls, set the reading of the frequency indicator on receiver A to the operating frequency of the desired station. If necessary, calibrate the frequency indicator as instructed in paragraph 35. During the tuning process, a plus or minus sign may appear between the mc and kc readings on the frequency indicator. This is caused by overtravel of the KILOCYCLE CHANGE control. To obtain a correct reading, turn the MEGACYCLE CHANGE control one position in the direction indicated by the sign (increase frequency if the sign is plus, decrease frequency if the sign is minus); then turn the KILOCYCLE CHANGE control until the kilocycle element of the frequency indicator reads the same as it did previously, *without* the plus or minus sign.

(2) The presence of the incoming signal will be indicated by a beat note in the receiver headset and a reading on the CARRIER LEVEL meter. Adjust the LOCAL GAIN control for a comfortable audio level in the headset. Adjust the ANT TRIM control for a maximum reading on the CARRIER LEVEL meter. *Do not* touch the BFO PITCH control during tuning.

(3) With the KILOCYCLE CHANGE control, tune in the signal. Because the signal is shifting in frequency, tune this control so that the two frequencies produce approximately equal audio notes and indicate that they are correctly centered in the pass band.

(4) The BFO switch may be left on except for very weak signals. If the noise is excessive, rotate the LIMITER control clockwise, as needed.

(5) Reduce the BANDWIDTH control by an amount depending on the type of signal received and the desired degree of receiver selectivity to be used. Generally, the BANDWIDTH control should be set at 2 KC for a single-channel frequency shift signal and at 4 KC for a time division multiplexed signal. However, it may be desirable to use a greater degree of receiver selectivity under conditions of high interference. The BANDWIDTH control may be set to 1 KC for a fsk signal and to 2 KC for a time division multiplexed signal. However, very precise tuning of the receiver is necessary when these narrow-band settings are used and, during operation, the equipment must be monitored constantly to insure against an inadequate output due to drifting of the signal away from the receiver if pass band.

(6) Tune receiver B the same as receiver A ((1) through (5) above).

(7) Return the LOCAL GAIN controls of both receivers to 0, and leave them there for all subsequent operations unless the incoming fsk signal is modulated by voice or other audio intelligence.

e. Tuning the Converter.

(1) Rotate the CHANNEL SELECTOR control to A.

(2) Slowly readjust the KILOCYCLE CHANGE control on receiver A and note the CHANNEL A DISCRIMINATOR meter on the converter. Tune the receiver until the CHANNEL A DISCRIMINATOR meter needle deflects symmetrically to each side of zero for a miscellaneous keying signal input. The reading on the CHANNEL A SIGNAL INPUT meter should now indicate a maximum input level from the receiver. If possible, a full scale reading of the SIGNAL INPUT meter should be obtained. When a four-channel time division signal is received, this instruction does not apply (par. 32).

(3) Rotate the CHANNEL A AFC-XTAL-MARK HOLD switch to the left-hand XTAL position. Turn the teletypewriter printer on and check the copy. If the printing has no meaning, rotate the AFC-XTAL-MARK HOLD switch to the right-hand XTAL position. The teletypewriter should now print correct copy.

(4) Rotate the CHANNEL SELECTOR control to position B.

(5) With receiver B and the DISCRIMINATOR and SIGNAL INPUT meters for channel B, tune channel B the same as channel A.

(6) Rotate the CHANNEL SELECTOR control to the A+B position. Radio Receiving Set AN/FRR–38 is now ready for diversity operation. The converter heterodyne oscillator is crystal controlled; afc or manual frequency control operation is discussed in paragraph 28 and 30. Single-channel (nondiversity) operation is discussed in paragraph 28.

28. Afc Operation

After the converter is tuned as described in paragraph 27*e*, it should be operated normally on afc. This does not apply when receiving time division multiplexed signals (par. 32). In afc operation, the afc circuit detects frequency drifts due to slight frequency changes in the transmitter, the receiver, or the converter, and keeps the converter properly tuned. Therefore, when afc operation is used, readjustment of the converter and/or the receiver is not required to maintain a constant nondistorted, output to the teletypewriter. To place the converter in afc operation, throw the AFC toggle switch to ON and proceed as follows:

a. Rotate the CHANNEL SELECTOR switch to position A.

b. Rotate the CHANNEL A AFC-XTAL-MARK HOLD switch to the right- or left-hand AFC position that corresponds to the XTAL position that is necessary for correct copy when originally tuning the converter.

c. Turn the CHANNEL A AFC SHIFT ADJUSTMENT until the AFC INDICATOR stops spinning. The teletypewriter should start printing correct copy.

d. Note the DISCRIMINATOR meter. Carefully readjust the AFC SHIFT ADJUSTMENT until the DISCRIMINATOR meter fluctuates evenly about zero for miscellaneous keying signals.

e. Adjust the CHANNEL A AFC THRESHOLD LEVEL control to the highest numbered position that does not allow weak signals to operate the teletypewriter. A practical way to determine this setting is to advance the control in a clockwise position until the teletypewriter which is being operated is placed in a mark-hold condition. The control may then be returned to the point where the teletypewriter *begins* again to print correct ungarbled copy. The setting of this control is subject to change because of changing transmission conditions.

f. Rotate the CHANNEL SELECTOR control to the B position, and repeat the adjustment of the AFC SHIFT ADJUSTMENT for channel B. It is unnecessary to adjust the AFC SHIFT ADJUSTMENT controls for both channels when using nondiversity operation.

g. Return the CHANNEL SELECTOR control to the A+B position for diversity operation.

Allow it to remain set at the appropriate channel (A or B) if nondiversity operation is to be used.

h. If the rf input signal level drops below that which was selected for operation by setting the AFC THRESHOLD LEVEL control, a steady marking signal will be delivered as output from the converter. This prevents the teletypewriters from running wild when signal level, which is unsatisfactory for proper operation of the equipment, is received from the transmitting station. When the afc DRIFT INDICATOR reaches the end of its travel because of frequency drift in the transmitter, a bell will ring. When this occurs, retune the receiver and the converter for both channels (or a single channel in nondiversity operation) to resume system operation. Depending on the rate of change at which the frequency drift takes place, and the rapidity with which the operator acts, it is possible to retune the equipment without interrupting operation by turning the receiver KILOCYCLE CHANGE control slowly until the DRIFT INDICATOR once more registers zero. Increase the frequency at the receiver if the DRIFT INDICATOR has reached +3. Decrease the frequency at the receiver if the DRIFT INDICATOR has reached −3. If this procedure does not reestablish correct operation of the system, retune the receiver and the converter as instructed in paragraph 27.

29. Crystal Controlled Oscillator Operation

To place the equipment in crystal controlled operation, follow the procedure described in paragraph 27. During operation, check the equipment to see if the DISCRIMINATOR meters on the converter indicate any drift in input frequency by a tendency to deviate from a condition of equal fluctuation about zero. If either meter indicates a drift, carefully readjust the appropriate receiver KILOCYCLE CHANGE control to reestablish the condition in which the DISCRIMINATOR meter fluctuates symmetrically to each side of zero for the miscellaneous keying signal input.

30. Manually Tuned Vfo Operation

To operate the equipment with manual control of the converter heterodyne oscillator frequencies, perform the operations indicated in paragraph 27 and proceed as follows:

a. Reset the CHANNEL SELECTOR switch to position A and rotate the CHANNEL A AFC-XTAL-MARK HOLD switch to the right- or left-hand AFC position. This position must correspond to the XTAL position that is required for correct copy as determined during the tuning procedure (par. 27).

b. Carefully tune the CHANNEL A DRIFT INDICATOR control until the CHANNEL A DISCRIMINATOR meter fluctuates evenly about zero on miscellaneous keying signals.

c. Rotate the CHANNEL SELECTOR switch to the B position, and repeat the tuning process. Use the CHANNEL B DRIFT INDICATOR control to obtain the proper positioning of the CHANNEL B DISCRIMINATOR meter. If single-channel operation is used, adjust only the DRIFT INDICATOR control of the appropriate channel.

d. Rotate the CHANNEL SELECTOR control to A+B for diversity operation. Allow the control to remain set to the appropriate channel position (A or B) for nondiversity operation.

e. Check the DISCRIMINATOR meters fluctuations periodically to insure proper operation of the converter. If necessary, readjust the DRIFT INDICATOR controls to reestablish proper converter tuning.

31. Single Channel (Nondiversity) Operation

The tactical situation may dictate the use of nondiversity operation. This type of operation is not as dependable as diversity operation and provides no protection against garbling of copy through signal fading which is due to adverse atmospheric conditions, changing skip distance, etc. Generally, nondiversity operation is suitable only over relatively short distances and when atmospheric conditions are favorable. To place the receiving set on single-channel operation, tune the equipment as instructed in paragraph 27, using only one receiver. Set the converter CHANNEL SELECTOR switch to A or B, depending on the receiver used, and do not move it from this position during nondiversity operation.

32. Time Division Multiplexing Operation

When the receiving set is used in a system with time division multiplexing, the operating procedure for the converter differs slightly from that used when a single-channel fsk signal is being received. The DISCRIMINATOR meter will not necessarily fluctuate evenly about zero when the converter has been properly tuned. This meter reading will depend on how many of the

possible channels available are being used at any given time. Thus, when the receiving set output is delivered to an equipment such as Teletype Terminal Equipment AN/FGC–5 which has four channels of output, the DISCRIMINATOR meters of the converter will fluctuate about some center other than zero when only three of the four available channels contain intelligence. Because of this characteristic, proper tuning of the converter to a multiplexed signal of this kind must be determined by observing received copy. If available, use an accessory tuning indicator that is connected at the output of the channel A and B (fig. 18) afc discriminator output circuits.

33. Antijamming Instructions

When it is first noticed that the received signal is being jammed, the operator will promptly notify his immediate superior. Under no condition will he stop operating. To reduce the effects of jamming so that the signal is received with the least amount of interference, proceed as follows:

a. Set the BANDWIDTH switch to .1 KC.

b. Adjust the ANT TRIM control for maximum readable output signal.

c. If the noise is severe, adjust the LIMITER control.

d. When the jamming signal is not too strong, set the FUNCTION switch to MGC and turn the RF GAIN control down. The interfering signal might be sufficiently reduced to permit part of the desired signal to come through.

e. Switch to AGC and try different time constants.

f. Do not use AFC on the converter.

g. Try different and more highly directional antennas.

h. If these steps do not provide some degree of signal separation, request a change in frequency and call sign.

i. If the jamming action is such that communication is impossible, report this fact to your immediate superior. Continue to operate.

34. Stopping Procedure

The stopping procedure of the equipment is the same for all types of operation. For best frequency stability the equipment should be left in STAND BY position when not in use.

a. Throw the POWER switch of the converter to OFF.

b. Rotate the FUNCTION switch of both receivers to OFF.

35. Calibration of Receiver Frequency Indicator

Calibration of the receiver is necessary whenever the MEGACYCLE CHANGE control is operated to select another band or when tuning from one extreme end of a 1 mc range to the other. To maintain the tuning accuracy of the receiver, calibrate the frequency indicator at the point nearest the frequency desired for reception. Calibration is accomplished by the use of the internal calibration oscillator as follows:

a. Set the BANDWIDTH to the .1 KC position.

b. Set the AUDIO RESPONSE to MED.

c. Set the RF GAIN control to 10.

d. Set the LOCAL GAIN control to 5.

e. Set the BFO switch to ON.

f. Turn the FUNCTION switch to CAL.

g. Adjust the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls for a reading on the frequency indicator at the 100 kc point nearest the frequency desired for reception.

h. Turn the ZERO ADJ clockwise as far as it will go.

i. Rotate the ANT TRIM to obtain an indication on CARRIER LEVEL meter.

j. Adjust the KILOCYCLE CHANGE control for maximum indication on the CARRIER LEVEL meter. Maximum should be obtained with only a slight adjustment of the control in either direction. If a maximum reading is not obtained within the limits of travel of the KILOCYCLE CHANGE control, as set by the ZERO ADJ knob, the vfo tuning shaft must be synchronized (TM 11–856).

k. Turn the BFO PITCH control to produce zero beat. If the BFO PITCH control does not produce a zero beat at a reading of 0 on its scale, loosen the set screw at the base of its control knob, and set the pointer at 0. Then tighten the set screw.

l. Turn the ZERO ADJ counterclockwise as far as it will go. The dial and bfo are now calibrated accurately.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

36. General

The operation of the receiving set may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. The following paragraphs in this section give instructions on procedures for minimizing the effects of these unusual operating conditions.

37. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry.

c. Locate the equipment inside a heated inclosure.

d. When equipment which has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly.

38. Operation in Tropical Climates

When operated in tropical climates, the high relative humidity causes condensation of moisture on the equipment whenever the equipment temperature becomes lower than the ambient air. To minimize this condition, provide adequate ventilation. If temperatures are very high, remove the rear door and blank panels of the cabinet.

39. Operation in Desert Climates

a. The main problem that arises with equipment operation in desert areas is the large amount of sand, dust, or dirt that enters the moving parts of radio equipment, such as motors and power units. The ideal preventive precaution is to house the equipment in a dustproof shelter. Because such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the side walls of tents with sand to prevent their flapping in the wind.

b. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

c. Keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (par. 45). Pay particular attention to the lubrication. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

d. The drastic fall in temperature at night often causes condensation on the equipment. For protection, cover it with a tarpaulin or similar material.

CHAPTER 3
ORGANIZATIONAL MAINTENANCE

Section I. TOOLS AND EQUIPMENT

40. Tools and Materials Required

The tools and materials contained in Tool Equipment TE–41 (the ordinary hand tools and materials normally available to organizational maintenance personnel) are required for organizational maintenance of Radio Receiving Set AN/FRR–38. In addition, Solvent, Dry Cleaning (SD) (Federal P–S–661) should be available.

41. Special Tools Supplied with Radio Receiver R–390/URR

(fig. 26)

The special tools supplied with the receiver are mounted on the back panel (fig. 26). The use of these tools is described in *a* through *d* below. Spare 20 ampere, 3 ampere and ⅜ ampere fuses are mounted on the rear panel of the receiver, under a protective cover.

a. Tube Pullers. Two cable grip-type tube pullers are furnished—one for seven pin minature tubes and the other for nine pin miniature tubes. To remove a tube, slide a tube puller of the proper size over the tube envelope. Pull upward on the tool and at the same time, wobble it slightly. After the tube has been removed from the socket, remove the tube from the puller by pushing the tube out toward the handle.

b. Right-Angle Phillips Screwdriver. The No. 8 right-angle screwdriver is used to remove the screws that secure dust covers, front panel, removable subchassis, terminal strips, etc.

c. Fluted Socket Wrench. The No. 8 fluted socket wrench is used for removing the front panel bar knobs and the MEGACYCLE CHANGE and KILOCYCLE CHANGE knobs, and for loosening the collars that secure the camshafts and gears in the mechanical tuning system.

d. Pin Straighteners. The seven pin and nine pin straighteners are attached to the back panel. When a miniature tube is inserted into the receiver, either after maintenance or for replacement purposes, it first should be inserted into the proper pin straightener to aline the pins properly.

Section II. PREVENTIVE MAINTENANCE SERVICES

42. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair in that its object is to prevent certain troubles from occurring.

43. General Preventive Maintenance Techniques

a. Use No. 000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with solvent (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a soft brush moistened with carbon tetrachloride; then wipe them dry with a cloth.

Caution: Repeated contact of carbon tetrachloride with the skin, or prolonged breathing of fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry, compressed air may be used at a line pressure not exceeding 60 pounds per square inch (psi) to remove dust from inaccessible places; be careful, however, because mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

44. Use of Preventive Maintenance Forms

(figs. 30 and 31)

a. The decision as to which items on DA Forms 11–238 and 11–239 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items in figures 30 and 31 are partially or totally applicable to the receiving set. References in the ITEM block refer to pargaraphs in the text which contain additional maintenance information. For information concerning the maintenance of an individual component, refer to the applicable technical manual.

45. Performing Preventive Maintenance

a. Exterior Items.

Caution: Tighten screws, nuts, and bolts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

(1) Check the equipment against the table of components (par. 8) and the list of running spares (par. 13) to see that no components or parts are missing. Observe the general condition of the equipment.

(2) Check the suitability of location and installation for normal operation (fig. 10, par. 15).

(3) Use a clean, lint-free cloth to remove dust, dirt, and moisture from the headsets, loudspeakers, glass windows of the frequency indicators and converter meters, front and rear panels, and inside the cabinet.

(4) Inspect for proper seating of the antenna lead-in cables, if interconnecting cables, headset and loudspeaker plugs, power plugs in the receptacle strip, and TT output connector (fig. 18). Remove any dirt or moisture that may have accumulated on these connectors. Check the seating of fuses located at rear of components. Check the seating of tubes and crystal holders.

(5) Inspect all controls for binding, scraping, or excessive looseness. Check those controls with detent mechanisms for positive action.

(6) Check for normal operation of the receiving set. Check for normal operation of the receiving set as part of the system (par. 54).

(7) Clean and tighten the panel and track mountings that hold the components in the cabinet (par. 17). Check the mountings by which the cabinet is secured in its place of installation.

(8) Inspect the cabinet and the components for signs of moisture and corrosion. Remove rust spots with No. 000 sandpaper. Touch up the bare spots (par. 49).

(9) Inspect interconnecting cords and cables for cuts, tears, kinks, mildew, or fraying (fig. 18).

(10) Inspect the antennas for weather damage, bends, corrosion, loose fit, cracked or broken insulators, and damaged guys. If whip antennas are being used, inspect them for bending. If they are bent, straighten them. If they cannot be straightened, replace them. Replace broken ceramic insulators or, with rhombic antennas, damaged termination resistors.

(11) Check for looseness of the front panel control switches and knobs of the receiver and converter components. Tools are provided with the receiver for tightening control knobs. The converter controls may be tightened on their shafts by using an ordinary screw driver.

(12) Clean the jewel assembly of the converter pilot lamp.

(13) Inspect the glass of the meters and the frequency indicators for breakage. Make certain the screws that hold this glass in place are not loose.

(14) If deficiencies noted are not corrected during inspection, indicate action taken for correction.

b. Internal Items.

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect the power and check for satisfactory operation.

(1) Do not work on tubes immediately after shutdown. Severe burns may result from

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
RADIO RECEIVING SET AN/FRR-38	

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* PAR. 45 a (1)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 45 a (2)							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 45 a (3)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 45 a (4)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 45 a (5)							
6	CHECK FOR NORMAL OPERATION. PAR. 45 a (6)							

WEEKLY

NO.	ITEM	CONDITION	NO	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 45 a (7)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 45 a (8)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 45 a (12)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 45 a (9)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 45 a (13)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. PAR. 45 a (10)		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 45 a (11)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR. 45 a (14)

DA FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 647-18

Figure 30. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: **RADIO RECEIVING SET AN/FRR-38**

EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (1) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
(1)	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*). PAR.45a(1)	
(2)	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR.45a(2)	
(3)	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR.45a(3)	
(4)	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR.45a(4)	
(5)	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR.45a(5)	
(6)	CHECK FOR NORMAL OPERATION. PAR.45a(6)	
(7)	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR.45a(7)	
(8)	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR.45a(8)	
(9)	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR.45a(9)	
(10)	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. PAR.45a(10)	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.	
(12)	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR.45a(11)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
(14)	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR.45a(12)	
(15)	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR.45a(13)	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

NO.	ITEM	CONDITION
(19)	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR.45b(1)	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION.	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE.	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS.	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE.	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE.	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
(37)	MOISTURE AND FUNGIPROOF. PAR.45b(2)	
(38)	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR.45a(14)	

DA FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—64382-1

Figure 31. DA Form 11–239.

contact with hot envelopes. Inspect glass envelopes for cracks and accumulation of dirt. Inspect firmness of tubes in their sockets. Press them firmly, but gently, straight down in their sockets. Do not jiggle the tubes from side to side because this may break the pins or spread the contacts of the socket. Inspect tube sockets at times when removal of the tubes is required. Check tubes for emission and short-circuited electrodes; use Electron Tube Test Set TV–7/U. Check for corroded pins on tubes and crystals. Clean with No. 000 sandpaper.

(2) Check adequacy of moistureproofing and fungiproofing treatment (pars. 48 and 49).

Section III. LUBRICATION

46. Lubrication under Normal Conditions

Lubrication instructions for the receiver and converter components of this equipment are given in the individual technical manuals for each component. No lubrication is required for the cabinet or for the sliding rails used to mount the components in the cabinet.

47. Lubrication under Unusual Conditions

The effects of extreme cold and heat on lubrication materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat.

Section IV. WEATHERPROOFING

48. Weatherproofing Procedures and Precautions

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72.

c. Arctic Maintenance. Special precautions necessary to prevent poor performance or total failure of equipment in extremely low temperatures are explained in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75.

49. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touchup painting of bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles of metal frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touchup job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section V. TROUBLESHOOTING AT ORGANIZATIONAL LEVEL

Note. Unit troubleshooting at a field maintenance level is covered in TM 11–856 and the converter manual.

50. General

a. The troubleshooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, troubleshooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, etc.

b. The paragraphs that follow in this section help in determining which of the components, a receiver or the converter, are at fault and in localizing the fault in that component to the defective stage or item, such as a tube or fuse.

51. Visual Inspection

a. Many of the faults that appear in the receiving set may be detected by a visual inspection of the system components. Pilot lamps are used to indicate when each component is turned on and properly connected to the power source. If a pilot lamp fails to light, check to see that the power cords are connected properly (fig. 18) and that plugs are seated firmly in their receptacles.

b. One type of fault is the improper setting of switches and controls. Check the switch and control settings for the type of operation being used. If different antennas are being used for different operating frequencies, check to see that the correct antenna is connected for the frequency at which reception is being attempted.

52. System Sectionalization of Trouble to a Component

a. System sectionalization consists of determining whether the trouble lies in one of the receivers, the frequency shift converter, or in the interconnecting facilities provided by the cabinet.

b. Operate the entire receiving set and observe its performance. Refer to the equipment performance check list (par. 54) for normal operating indications.

(1) If the entire equipment is inoperative and none of the pilot lamps light, the trouble is probably in the power source or at the switch box in the electrical equipment cabinet.

(2) If only one component is completely inoperative, the trouble is in that component and may be a burned-out fuse. Generally, the component will resume operation upon replacement of a bad fuse. If the replacement fuse burns out immediately upon installation, do not replace the fuse again until the source of trouble is determined.

(3) If the signal, as indicated by meter readings, audible indications, etc., is present in the receivers but not in the converter, the trouble may be a defective connector or interconnecting cable.

(4) If correct operation of the receiving set is indicated by proper meter readings on the converter, but the teletypewriter (TY) equipment is inoperative, the trouble probably lies in the TY equipment, its control unit, or interconnecting cabling. This part of the receiving system should be checked using the appropriate technical manuals.

c. Excessive noise delivered from one or both receivers may cause poor operation of the converter. To determine the source of such noise, disconnect the antenna from a receiver and listen with a headset connected to the receiver to determine if there is an appreciable decrease in the noise level when the antenna is removed. If the noise level drops, the source of noise is probably external to the equipment and may be caused by atmospheric conditions or noise generating equipment located too close to the receiving antennas. If the noise persists, the trouble probably lies in the receiver. Use the procedure described above, and check both receivers to make absolutely certain the source of noise is within one of the receivers. It is very unlikely that a trouble producing excessive noise would occur simultaneously in both receivers.

d. By use of procedures similar to the simple checks given above, the trouble usually can be isolated to a particular component of the receiving set. Make full use of the organizational maintenance section in the individual manuals that cover the receiver and converter when performing these checks. If these tests do not isolate the trouble, use the equipment performance check list (par. 54).

53. Troubleshooting by Using the Equipment Performance Check List

a. General. The equipment performance check list (par. 54) will help the operator to locate trouble in the equipment. The chart gives the component to be checked, the conditions under which the component is checked, the normal indications of correct operation, and the corrective measures the operator may take. The operations listed in the chart should be followed in sequence. Items marked RECEIVER pertain to both receivers in the equipment.

b. Action or Condition. The action or condition column of the table refers either to a control setting under which the component must be

checked or to an action that must be taken to obtain the normal indication listed.

c. Normal Indications. The normal indications listed include the visible and audible signs the operator should perceive when the equipment is operating properly. If the indications are not normal, the operator should apply the necessary corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator may make without turning the equipment in for repairs. A reference in the check list to a paragraph or another technical manual indicates that the trouble probably cannot be corrected during operation and that troubleshooting by an experienced repairman is necessary. If the set is completely inoperative, or if the recommended corrective measures do not yield results, troubleshooting is necessary. However, if the tactical situation requires that communication be maintained and if the set is not completely inoperative, the operator must attempt to maintain the set in operation as long as it is possible to do so.

e. Associated Technical Manuals. Because manuals have been published for both the receiver and the converter, advantage should be taken of these manuals in solving difficulties within the individual components of the receiving set. The function of the equipment performance check list (par. 54) is primarily to sectionalize the trouble to one of the individual components. Detailed troubleshooting procedures for the receivers and the converter are given in TM 11–856 and the converter manual.

54. Equipment Performance Check List

	Item No.	Item	Action or condition	Normal indications	Corrective measures
RECEIVER PREPARATORY	1	Ac line switch S1001 (on Cabinet CY–1119/U).	Turned to ON.		
	2	Antenna.	Lead-in wire connected.		
	3	Loudspeaker or headset.	Loudspeaker connected to LOCAL AUDIO terminals 6 and 7 or headset connected to PHONES jack.		
	4	600 ohm line.	Connected to terminals 10 and 13. If 600 ohm line is not available, connect headset to terminals for test purposes.		
	5	Power cable.	Connected between receiver and power source.		
	6	IF OUTPUT 50 OHMS (J106).	Connected to A or B INPUT at converter.		
	7	AUDIO RESPONSE switch.	Set at MED.		
	8	BANDWIDTH switch.	Set at 4 or 8 KC.		
	9	RF GAIN.	Set at 10.		
	10	LOCAL GAIN control.	Set at 5.		
	11	Terminal strips.	The following pairs of terminals on the rear terminal strips are connected together: 1 and 2, 4 and 5, 11 and 12, 14 and 15 on each receiver. Terminal 3 of receiver A is connected to 3 of receiver B.		

	Item No.	Item	Action or condition	Normal indications	Corrective measures
CONVERTER PREPARATORY	12	Power Cable.	Connected between converter and power source.		
	13	A and B INPUT receptacles.	Connected to IF OUTPUT 50 OHM (J106) in appropriate receivers.		
	14	TT output receptacle.	Connected to teletypewriter or control unit.		
	15	AFC switch.	OFF.		
	16	AFC SHIFT ADJUSTMENT controls.	Set at 0.		
	17	CHANNEL SELECTOR switch.	Set to A.		
	18	AFC-XTAL-MARK HOLD switches.	Set to MARK HOLD.		
	19	DRIFT INDICATOR controls	Set at 0.		
START RECEIVER	20	Receiver FUNCTION switch.	Turn to AGC.	Dial lamps light.	Check power cable. Check dial lamps and 3 ampere fuses at receiver rear panel. S1001 line switch ON. Refer to TM 11–856.
				Rushing noise or signal is heard in headset.	Test tubes. Check connectors between subchassis. Refer to TM 11–856.
CONVERTER START	21	POWER switch.	ON.	Pilot lamp lights.	Check power cable. Check pilot lamp and 3 ampere fuse at converter rear panel. S1001 line switch ON. Test tubes. Refer to the converter manual.
RECEIVER PERFORMANCE	22	MEGACYCLE CHANGE control.	Set to each band, in turn.	Normal signal output on each band.	Rotate control several times to clean switch contacts. Refer to TM 11–856.
	23	KILOCYCLE CHANGE.	Tune across a band.	Signals received. CARRIER LEVEL meter indicates strength of signal.	Refer to TM 11–856.
	24	ANT TRIM.	Rotate control.	Obtain peak indication on CARRIER LEVEL meter for each band.	Refer to TM 11–856.
	25	LOCAL GAIN control.	Rotate control in either direction.	Volume at headset increases or decreases.	Refer to TM 11–856.

RECEIVER PERFORMANCE

Item No.	Item	Action or condition	Normal indications	Corrective measures
26	LINE GAIN control.	Rotate control.	Output level to 600 ohm line or headset and LINE LEVEL meter increases or decreases.	If headset level varies and pointer of meter is sticking, tap meter lightly. If it still sticks, the meter should be replaced. If local output is satisfactory but line output is weak, check tubes V602 and V604. Refer to TM 11–856.
27	RF GAIN control.	Rotate control.	Audio output and CARRIER LEVEL meter indication increases or decreases.	Refer to TM 11–856.
28	FUNCTION switch.	Turn to MGC.	With no signal input, noise level should increase and CARRIER LEVEL does not indicate.	Refer to TM 11–856.
		Turn to AGC and tune through several different signals.	Output volume nearly constant.	Refer to TM 11–856.
		Turn to CAL, and then operate KILOCYCLE CHANGE control.	Deflection on CARRIER LEVEL meter at each 100 kc reading.	Reset ANT TRIM control. Refer to TM 11–856.
		Turn to SQUELCH, and then operate the KILOCYCLE CHANGE control.	No reception of noise while tuning between stations.	If noise is high, turn RF GAIN control counterclockwise until squelch circuit is effective enough to reduce noise.
29	LIMITER control.	Turn clockwise.	Noise peaks are reduced in amplitude.	Refer to TM 11–856.
30	BREAK IN relay switch.	Turn to ON. Short BRK IN terminal 9 on rear panel to ground momentarily.	LINE LEVEL meter is disabled and break-in relay functions to silence receiver. Line audio output circuits to receiver REMOTE CONTROL receptacle are disconnected from receiver output-transformer.	Refer to TM 11–856.
31	LINE METER switch.	Turn to +10.	Line level is 10 vu above LINE LEVEL meter indication.	Refer to TM 11–856.
		Turn to 0.	LINE LEVEL meter indicates the line level controlled by the LINE GAIN control.	Refer to TM 11–856.
		Turn to −10.	Line level is 10 vu below LINE LEVEL meter indication.	Refer to TM 11–856.
		Turn to OFF.	LINE LEVEL meter is disconnected. Line audio output is still connected.	Refer to TM 11–856.
32	BFO OFF-ON control and BFO PITCH control.	Turn BFO control to ON. Tune in an am. or cw signal, and vary the BFO PITCH control.	Tone of signal varies.	Refer to TM 11–856.

CONVERTER PERFORMANCE

Item No.	Item	Action or condition	Normal indications	Corrective measures
33	CHANNEL A DISCRIMINATOR meter.	Readjust Receiver A KILOCYCLE CHANGE control.	Meter deflects symmetrically about zero on miscellaneous keying signal.	Check INPUT A cable connection. Refer to the converter manual.
34	CHANNEL A SIGNAL INPUT meter.	CHANNEL A DISCRIMINATOR meter deflects symmetrically about zero for miscellaneous keying signal.	Indicates maximum input.	Check INPUT A cable connection. Refer to the converter manual.
35	CHANNEL A and B XTAL-AFC-MARK HOLD switches.	In MARK HOLD position.	Teletypewriter runs closed.	Check converter TT output circuit to teletypewriter. Check 60 ma loop current. Refer to the converter manual.
36	CHANNEL A XTAL-AFC-MARK HOLD switch.	Rotate to left-hand XTAL position. If teletyped copy has no meaning, rotate switch to right-hand XTAL position.	Teletypewriter starts printing correct copy.	Check loop current adjustment (par. 25).
37	CHANNEL B DISCRIMINATOR meter.	Return CHANNEL A AFC-XTAL-MARK HOLD switch to MARK HOLD position.		
		Readjust RECEIVER B KILOCYCLE CHANGE control.	Meter deflects symmetrically about zero on miscellaneous keying signal.	Check INPUT B cable connection. Refer to the converter manual.
38	CHANNEL B SIGNAL INPUT meter.	CHANNEL B DISCRIMINATOR meter deflects symmetrically about zero for miscellaneous keying signal.	Indicates maximum input.	Check INPUT B cable connection. Refer to the converter manual.
39	CHANNEL A and B XTAL-AFC-MARK HOLD switches.	In MARK HOLD position.	Teletypewriter runs closed.	Check converter TT output circuit to teletypewriter. Refer to the converter manual.
40	CHANNEL B XTAL-AFC-MARK HOLD switch.	Rotate to left-hand XTAL position. If teletyped copy has no meaning, rotate switch to right-hand XTAL position.	Teletypewriter starts printing correct copy.	Check loop current adjustment (par. 25). Refer to the converter manual.
41	CHANNEL A AFC INDICATOR.	Return CHANNEL B AFC-XTAL-MARK HOLD switch to MARK HOLD position. Follow instructions in paragraph 31 for placing channel A in AFC operation.	CHANNEL A AFC INDICATOR moves, indicating AFC circuit and motor are tracking frequency changes. Teletypewriter prints correct copy.	Refer to the converter manual.
42	CHANNEL B AFC INDICATOR.	Return CHANNEL A AFC-XTAL-MARK HOLD switch to MARK HOLD position. Follow instructions in paragraph 31 for placing channel B in AFC operation.	CHANNEL B AFC INDICATOR moves, indicating AFC circuit and motor are tracking frequency changes. Teletypewriter prints correct copy.	Refer to the converter manual.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
RECEIVER STOP	43	OVENS OFF-ON switch.	Turn to OFF.	Oscillator ovens are turned off.	
	44	FUNCTION switch.	Turn to STAND BY.	Receiver is silent. Filament circuits and oscillator circuits are kept on for immediate reception.	
			Turn to OFF.	Turns off all receiver circuits.	
CONVERTER STOP	45	POWER switch.	Turn to OFF.	Pilot lamp goes off. Teletypewriters cease to operate.	

CHAPTER 4

SYSTEM THEORY

55. General

a. This chapter describes the system theory of the receiving set. The information presented is designed to aid in the efficient installation, operation, and maintenance of the receiving set. Manuals that cover all major components of the equipment, except the cabinet and the installation kit, have been published. Because these latter components perform only connecting and supporting functions in the operation of the equipment, no specific explanation of the theory of these components is necessary.

b. The radio set consists of two receivers and a frequency-shift converter which operate as a unit, and consequently involves the theory of both. Because the primary function of this equipment is the reception of radioteletype signals, emphasis is placed on this mode of operation.

56. Space and Frequency Diversity Operation

a. The use of space and frequency diversity for the transmission of radioteletype signals is intended to overcome the effects of fading radio signals. In the case of high-speed radioteletype operation, even short variations in signal strength have a marked effect upon the accuracy of a message. Fading is caused primarily by two factors: variation in the height of the ionosphere, which results in a changing skip distance of the radio signal, and the selection of two or more paths for the transmitted signal to arrive at the receiving antenna. This results in a time lapse between the two received signals, and causes them to cancel one another because of the phase difference that exists between them. Frequency diversity operation is based upon the theory that two radio signals of differing frequencies do not fade at any given receiving point at the same time. In the use of space diversity, it is assumed that a radio signal will not fade simultaneously at two points more than 600 feet apart. Of the two types of diversity transmission, space diversity is more frequently used, because only a single transmitter is required for operation while two transmitters are necessary when using frequency diversity operation.

b. The procedure for space diversity operation is as follows: Each of the receivers is fed from separate antennas (fig. 34), and the output from the if section of each receiver is delivered to the frequency-shift converter, which then combines the signals to deliver a constant keying signal through a control unit to a receiving teletypewriter. In space diversity operation, a satisfactory signal will be delivered to the teletypewriter when a signal of normal strength is received by one antenna, even though the signal at the other antenna has completely faded. Similarly, the system will function in the presence of relatively weak signals received simultaneously by both antennas. Space diversity operation, however, will not compensate for longtime fading of the signal caused by the wrong selection of a transmitter operating frequency with relation to the time of day and the geographical location of the transmitter.

57. Basic Circuits

a. Teletypewriter. Figure 32 shows the fundamental circuit used for operating two teletypewriters. All circuit components, including the dc power source, are series connected. This arrangement is called a *neutral circuit* because the transmission and reception of intelligence depend on the *make-and-break* of the sending contacts and the energizing and de-energizing of the selector magnet coils. Current flowing in a neutral circuit is known as a *mark* condition (A, fig. 32). When the circuit is broken so that no current flows in it, a *space* condition results (B, fig. 32). In teletypewriter operation, these mark (current) and space (no current) impulses are coded into a five unit group. The time interval necessary to send one of these groups is fixed. Various combinations of mark and space impulses are used to represent the letters of the alphabet, numerals, and the various punctuation

marks. In addition to the five impulses which make up the letter and symbol combinations, two other impulses are transmitted with each group representing the beginning and the end of each five pulse character group. These two additional impulses are known as the *start* and *stop* impulses. The start impulse is always a space and prepares the receiving teletypewriter selector mechanism for the reception of the character impulses which follow it. The stop impulse is always a mark and is used to stop the cycle of code transmission momentarily to make sure that perfect synchronism exists between the sending and the receiving mechanisms. A steady marking or a steady spacing output signal from the sending teletypewriter produces no intelligible reaction at the receiving teletypewriter. In the steady spacing condition, the receiving teletypewriter runs open. In the steady marking condition, the teletypewriter runs closed.

b. Neutral vs Polar Circuits. The term neutral circuit is used to describe an on-off keying circuit. A polarized keying circuit (one in which a positive voltage is used for a mark character, a negative voltage for a space character) is not normally used in radioteletype communication except in cases where the teletypewriters are remotely located from the radio equipment. The two types of waveforms are shown in figure 33. Radio Receiving Set AN/FRR–38 produces neutral output only. Some intermediate equipment capable of translating a neutral into a polar waveform is necessary to operate this equipment in a polar system.

c. Radioteletypewriter. All that is necessary for the operation of a radioteletypewriter system is a means of converting the neutral mark-space pulses into an rf carrier at the transmitting end of a system and a means of reconverting the rf carrier into neutral mark-space pulses at the receiving end of the system. A simplified block diagram of such a system is shown in figure 34. As in landline teletypewriter operation, the sending contact of a sending teletypewriter is closed to produce a mark impulse, or opened to produce a space impulse. This produces a neutral wave form output from the machine which is fed to a control unit. Similar signals are then fed from the control unit to a frequency-shift exciter. The frequency-shift exciter unit operates a radio transmitter to produce a *mark* frequency output from the transmitting antenna. A different transmitter output frequency is used for a *space* character. The output signal of the transmitter is received simultaneously at the two space diversity antennas, each connected to one radio receiver. The if output of each receiver is delivered to a frequency-shift converter that converts the transmitted mark frequency into a dc mark pulse. This pulse is delivered to a control unit which energizes the coil of the selector magnet in a receiving teletypewriter. This type of transmission (two different transmitter output frequencies, one for mark and one for the space impulse) is known as frequency-shift keyed (fsk) transmission. The frequency-shift converter in the receiving set will operate with frequency shifts ranging from 150 to 1,000 cps.

58. System Block Diagram
(fig. 35)

a. The path of the received signal from the receiving antennas to a receiving teletypewriter is shown in figure 35. An amplitude modulated frequency-shift signal is shown in the example. The teletypewriter intelligence appears in the signal as variations in its frequency. The voice intelligence appears as variations in the signal amplitude. This particular type of signal is usually employed over relatively short operating distances. The voice element in the signal is used to provide an order wire. Over greater distances, where more powerful transmitters are required, the signal normally is not amplitude modulated and appears like that illustrated in figure 34. Keying frequencies used in either signal may be separated by as little as 150 cps or as much as 1,000 cps with this equipment. The operating frequency may lie anywhere within the range of the receiver (.5–32 mc).

b. In figure 35, the transmitted signal is received on two space diversity antennas. In space diversity, the receivers are operated at the same frequency and a single transmitter is used. In a frequency diversity system, two different operating frequencies would be used, necessitating two transmitters. The difference between the two operating frequencies in a frequency diversity system is limited by the if selectivity of the receivers employed. Normally, both receivers would be operated from the same antenna in frequency diversity.

c. With frequency diversity or space diversity, the incoming signal is mixed with the receiver heterodyne oscillator frequency to produce an if. This 455 kc if center frequency has frequency

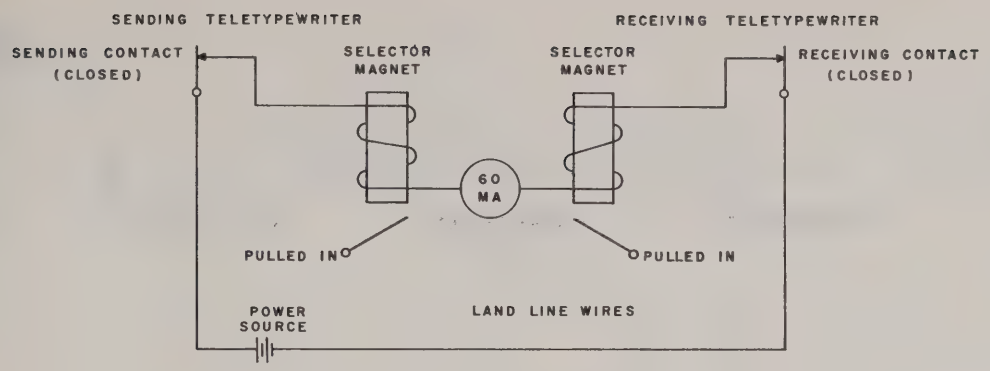


Figure 32. Landline teletypewriter circuit, simplified schematic.

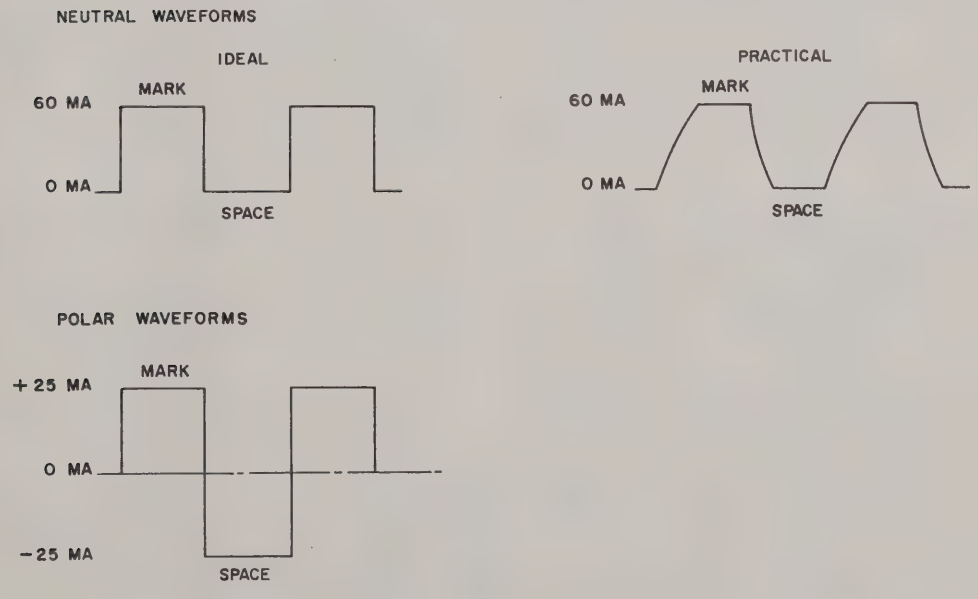


Figure 33. Neutral and polar waveforms.

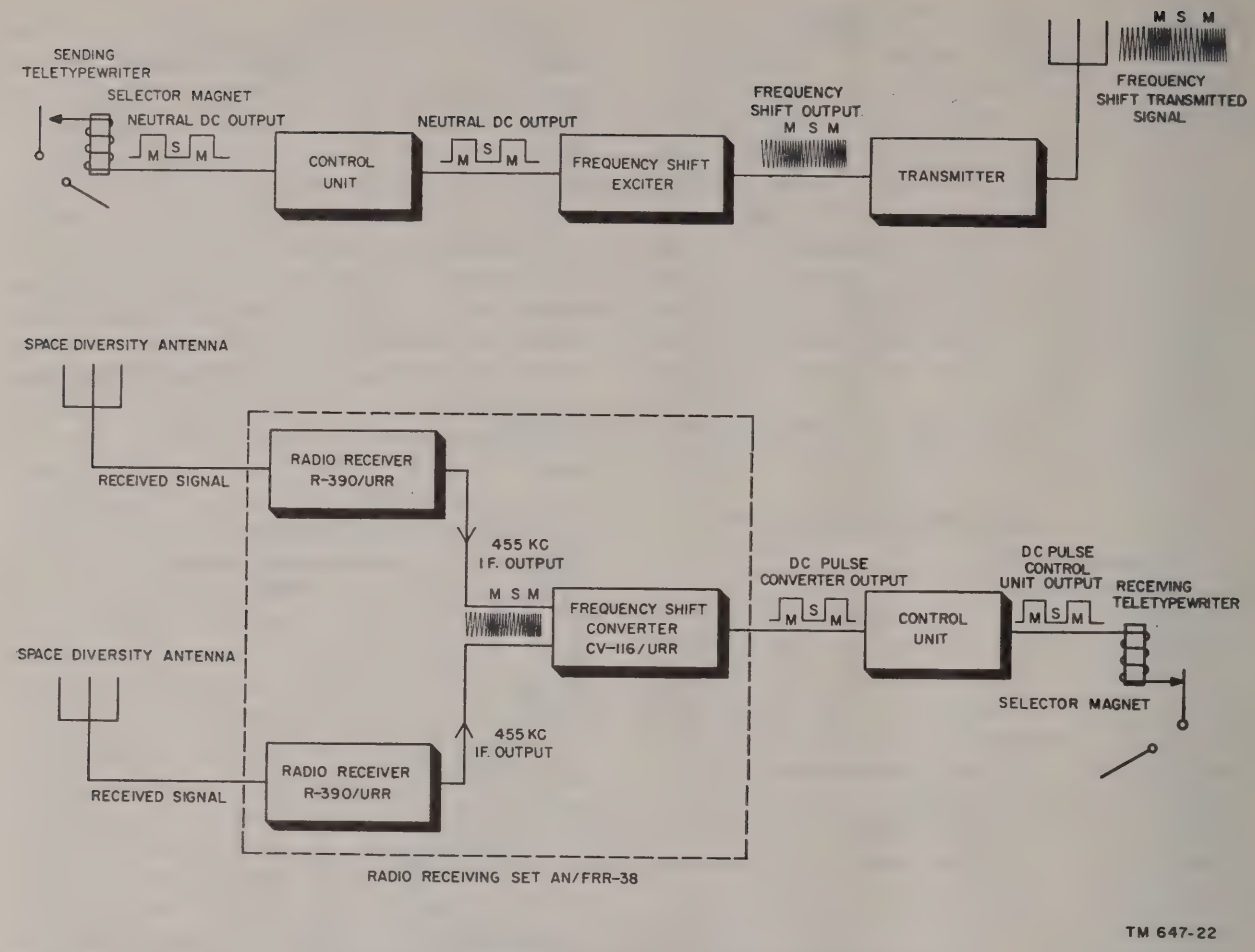


Figure 34. Typical radioteletypewriter system, block diagram.

shifts appearing at either side of 455 kc. This signal will also vary in amplitude at a rate dependent upon the af of the intelligence producing the modulation.

d. In the receiver detector section, the fsk signal, which is rf, is eliminated, while the am intelligence produces an audio output from the receiver.

e. The if output of each receiver is fed to the two input channels of the frequency-shift converter. The if output of receiver A is beat with the converter channel A heterodyne oscillator to produce a converter if of 50 kc. The if output of receiver B is beat with the channel B heterodyne oscillator to produce a converter if of 29.3 kc.

f. These two if signals are then fed to a common limiting amplifier that eliminates the variations in amplitude caused by noise and any original am of the transmitted signal. The converter first (common) limiting stages allow the two different if signals to be amplified and limited separately without mixing to form a common signal. The output of the common limiters consists of two separate signals, one in which the teletypewriter intelligence is frequency-shifted about a center frequency of 50 kc, and the other in which the teletypewriter intelligence is frequency-shifted about a center frequency of 29.3 kc.

g. The signals are then fed to two discriminator circuits. One discriminator is tuned at 50 kc, and the other at 29.3 kc. Each discriminator detects the rate at which its input signal shifts about its respective if. The combined dc output of the two discriminators is used to operate a keyer circuit that in turn keys the dc loop supply of a receiving teletypewriter. This keying action is usually accomplished through a control unit. With normal receiver input signal strength, either of the received signals is sufficient to produce a usable output from the converter. The effect in the discriminator is to add in phase the keyed element in one signal to the other to

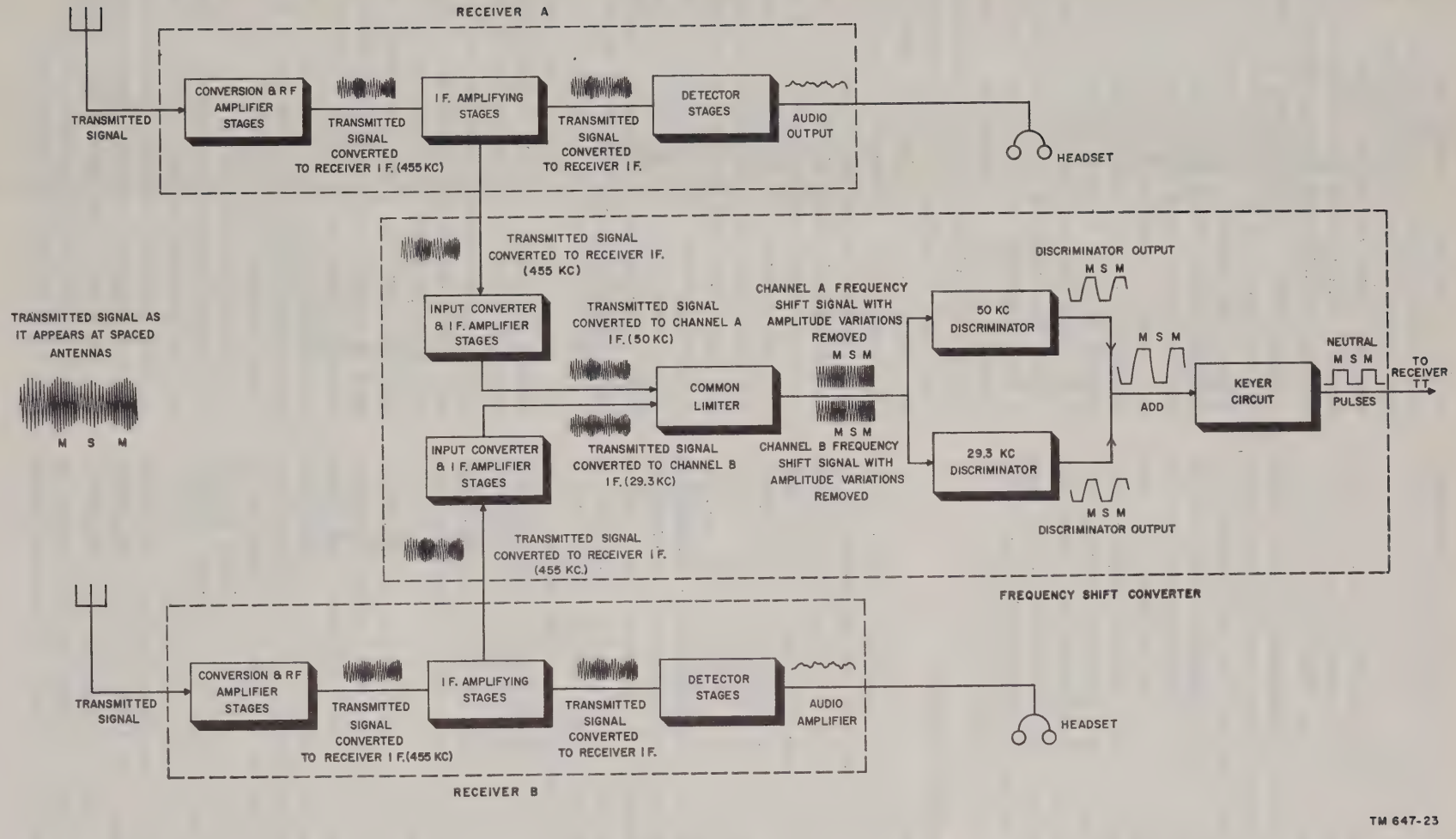


Figure 35. Radio Receiving Set AN/FRR–38, block diagram.

produce a satisfactory output from the receiving set under conditions of instantaneous signal fading at any one receiver.

h. To prevent distortion of the output waveform delivered by the receiving set, the converter has been provided with two afc circuits, one for each channel of operation. These circuits are shown in the converter block diagram, figure 38. Each circuit has its own discriminator, the output of which is used to operate a phase actuated motor which retunes the heterodyne oscillator in the applicable input circuit to hold the converter if center frequencies at their proper values. By operating at the end of the receiving system, the afc circuits in the converter compensate not only for frequency drifts occurring in the converter itself, but also for drifts originating in the receiver and the transmitter.

59. Receiver Block Diagram
(fig. 36)

The transmitted frequency-shift signal is received simultaneously by the antennas of receiver A and receiver B. The functions performed by these two receivers in the overall operation of the system is described in paragraph 58 above.

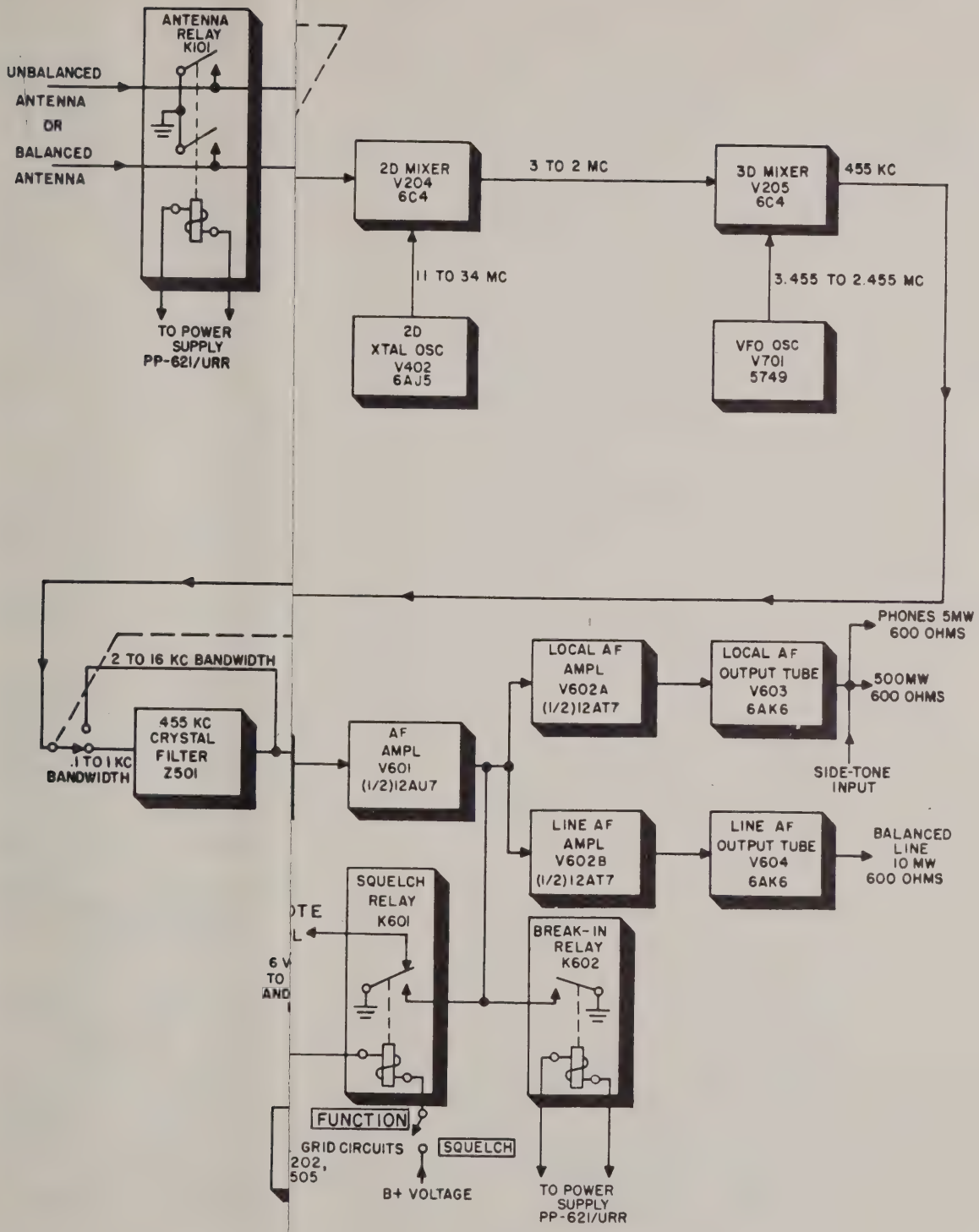
a. Although the receiver uses the basic heterodyne principle (the incoming signal is beat against a signal locally generated in the receiver to produce an if), the operation of its input circuit differs in detail from conventional types. The receiver employs triple conversion between .5 and 8 mc and double conversion from 8 to 32 mc. The end product of this conversion sequence is always a receiver if of 455 kc. Regardless of the conversion used, the output signal is not reversed and is always right-side-up with relation to the transmitted signal.

b. After the first and second rf amplifiers (V201 and V202), comes the conversion section which consists of three oscillators and three mixers. Two of these oscillators (V401 and V402) are crystal controlled, and the third (V701) is a highly accurate vfo that is permeability tuned. The MEGACYCLE CHANGE control on the front panel of the receiver selects the output frequency of the first two crystal oscillators by changing the crystal used in the tank circuit of the oscillator. The KILOCYCLE CHANGE control selects the frequency at which the third oscillator operates by changing the amount of inductance in its tank circuit. In addition to this oscillator frequency tuning, the MEGACYCLE and KILOCYCLE CHANGE controls also vary the inductance in the rf amplifier and mixer circuits. The conversion scheme is chosen to provide maximum rejection of images, harmonic frequencies and unwanted beat frequencies.

c. Between .5 through 8 mc, the incoming signal is subjected to three conversions. The signal is first beat against crystal oscillator V401 and the sum of the two signals (9 to 18 mc) is selected and fed to the input of the second mixer V204. A crystal is selected by the MEGACYCLE CHANGE control which places the output frequency of V402 between 11 and 34 mc. Oscillator V402, like oscillator V401, operates in 1-mc steps. The if output (3 to 2 mc) of second mixer V204 is delivered to third mixer V205. The vfo oscillator (V701) is controlled by the KILOCYCLE CHANGE control on the receiver front panel and is infinitely variable throughout its 1-mc range (3.455 to 2.455 mc), which is covered in 10 turns. It is through this oscillator that a fixed 455-kc if output is obtained.

d. When the MEGACYCLE CHANGE control is moved by the operator from a reading of 7 mc to a reading of 8 mc, a switch mechanically coupled to the control knob disables first crystal oscillator V401 and reconnects the input circuit so that first mixer V203 is bypassed. The incoming signal is delivered directly to second mixer V204. Frequencies between 8 and 32 mc are subjected to only two conversion stages.

e. When converted to the receiver if output of 455 kc, the signal is further amplified and unwanted frequencies are rejected in a series of six tuned if amplifiers. The output of the final if amplifier is delivered to detector V507, where the am signal is detected. The output of the detector is fed to the audio amplifiers through the series noise limiter. The audio is amplified and delivered as receiver output to a headset or loudspeaker. Between the fifth and sixth if amplifier stages, part of the if signal is tapped off and fed to isolating amplifier V511B, the circuit of which is shown in figure 37. Amplifier V511B functions as a cathode follower to provide a low-impedance if output to coaxial connector J106. The if signal voltage developed across resistor R550 (fig. 37) is coupled through capacitor C538 and delivered through receiver internal connectors J512 and P112 to J106. The signal then passes through Cord CG–409A/U to converter INPUT A receptacle J1 or INPUT B receptacle J5.


ANTENNA RELAY K101
UNBALANCED ANTENNA OR BALANCED ANTENNA
TO POWER SUPPLY PP-621/URR
2D MIXER V204 6C4
3 TO 2 MC
3D MIXER V205 6C4
455 KC
11 TO 34 MC
3.455 TO 2.455 MC
2D XTAL OSC V402 6AJ5
VFO OSC V701 5749
PHONES 5MW 600 OHMS
LOCAL AF AMPL V602A (1/2)12AT7
LOCAL AF OUTPUT TUBE V603 6AK6
500MW 600 OHMS
2 TO 16 KC BANDWIDTH
455 KC CRYSTAL FILTER Z501
.1 TO 1 KC BANDWIDTH
AF AMPL V601 (1/2)12AU7
SIDE-TONE INPUT
LINE AF AMPL V602B (1/2)12AT7
LINE AF OUTPUT TUBE V604 6AK6
BALANCED LINE 10 MW 600 OHMS
SQUELCH RELAY K601
BREAK-IN RELAY K602
FUNCTION
GRID CIRCUITS
SQUELCH
B+ VOLTAGE
TO POWER SUPPLY PP-621/URR
115/230 VOLTS AC 48-62 CPS

TM647-34

produce a satisfactory output from the receiving set under conditions of instantaneous signal fading at any one receiver.

h. To prevent distortion of the output waveform delivered by the receiving set, the converter has been provided with two afc circuits, one for each channel of operation. These circuits are shown in the converter block diagram, figure 38. Each circuit has its own discriminator, the output of which is used to operate a phase actuated motor which retunes the heterodyne oscillator in the applicable input circuit to hold the converter if center frequencies at their proper values. By operating at the end of the receiving system, the afc circuits in the converter compensate not only for frequency drifts occurring in the converter itself, but also for drifts originating in the receiver and the transmitter.

59. Receiver Block Diagram
(fig. 36)

The transmitted frequency-shift signal is received simultaneously by the antennas of receiver A and receiver B. The functions performed by these two receivers in the overall operation of the system is described in paragraph 58 above.

a. Although the receiver uses the basic heterodyne principle (the incoming signal is beat against a signal locally generated in the receiver to produce an if), the operation of its input circuit differs in detail from conventional types. The receiver employs triple conversion between .5 and 8 mc and double conversion from 8 to 32 mc. The end product of this conversion sequence is always a receiver if of 455 kc. Regardless of the conversion used, the output signal is not reversed and is always right-side-up with relation to the transmitted signal.

b. After the first and second rf amplifiers (V201 and V202), comes the conversion section which consists of three oscillators and three mixers. Two of these oscillators (V401 and V402) are crystal controlled, and the third (V701) is a highly accurate vfo that is permeability tuned. The MEGACYCLE CHANGE control on the front panel of the receiver selects the output frequency of the first two crystal oscillators by changing the crystal used in the tank circuit of the oscillator. The KILOCYCLE CHANGE control selects the frequency at which the third oscillator operates by changing the amount of inductance in its tank circuit. In addition to this oscillator frequency tuning, the MEGACYCLE and KILOCYCLE CHANGE controls also vary the inductance in the rf amplifier and mixer circuits. The conversion scheme is chosen to provide maximum rejection of images, harmonic frequencies and unwanted beat frequencies.

c. Between .5 through 8 mc, the incoming signal is subjected to three conversions. The signal is first beat against crystal oscillator V401 and the sum of the two signals (9 to 18 mc) is selected and fed to the input of the second mixer V204. A crystal is selected by the MEGACYCLE CHANGE control which places the output frequency of V402 between 11 and 34 mc. Oscillator V402, like oscillator V401, operates in 1-mc steps. The if output (3 to 2 mc) of second mixer V204 is delivered to third mixer V205. The vfo oscillator (V701) is controlled by the KILOCYCLE CHANGE control on the receiver front panel and is infinitely variable throughout its 1-mc range (3.455 to 2.455 mc), which is covered in 10 turns. It is through this oscillator that a fixed 455-kc if output is obtained.

d. When the MEGACYCLE CHANGE control is moved by the operator from a reading of 7 mc to a reading of 8 mc, a switch mechanically coupled to the control knob disables first crystal oscillator V401 and reconnects the input circuit so that first mixer V203 is bypassed. The incoming signal is delivered directly to second mixer V204. Frequencies between 8 and 32 mc are subjected to only two conversion stages.

e. When converted to the receiver if output of 455 kc, the signal is further amplified and unwanted frequencies are rejected in a series of six tuned if amplifiers. The output of the final if amplifier is delivered to detector V507, where the am signal is detected. The output of the detector is fed to the audio amplifiers through the series noise limiter. The audio is amplified and delivered as receiver output to a headset or loudspeaker. Between the fifth and sixth if amplifier stages, part of the if signal is tapped off and fed to isolating amplifier V511B, the circuit of which is shown in figure 37. Amplifier V511B functions as a cathode follower to provide a low-impedance if output to coaxial connector J106. The if signal voltage developed across resistor R550 (fig. 37) is coupled through capacitor C538 and delivered through receiver internal connectors J512 and P112 to J106. The signal then passes through Cord CG–409A/U to converter INPUT A receptacle J1 or INPUT B receptacle J5.

ANTENNA RELAY K101
UNBALANCED ANTENNA
OR
BALANCED ANTENNA
TO POWER SUPPLY PP-621/URR
.5 TO 32 MC
ANTENNA TRANSFORMERS .5 TO 32 MC
.5 TO 32 MC
.5 TO 32 MC (100 KC STEPS)
CALIBRATION OSC TUBE V901A (1/2)12AU7
1 MC
MULTI-VIBRATOR V902 12AU7
.5 TO 32 MC (100 KC STEPS)
BUFFER AMPL V901B (1/2)12AU7
FUNCTION
CAL
B+ VOLTAGE
1ST RF AMPL V201 6AJ5
.5 TO 32 MC
TO 1ST I.F. AMPL V501
TB102
1
2
RF GAIN
RF GAIN CONTROL
2D RF AMPL V202 6BJ6
TO 5TH I.F. AMPL V505
MEGACYCLE CHANGE
8 TO 32 MC BANDS
.5 TO 8 MC BANDS
1ST MIXER V203 6C4
9 TO 18 MC
8.5 TO 10 MC
1ST XTAL OSC V401 6AJ5
2D MIXER V204 6C4
3 TO 2 MC
11 TO 34 MC
2D XTAL OSC V402 6AJ5
3D MIXER V205 6C4
455 KC
3.455 TO 2.455 MC
VFO OSC V701 5749
BANDWIDTH
2 TO 16 KC BANDWIDTH
.1 TO 1 KC BANDWIDTH
455 KC CRYSTAL FILTER Z501
1ST I.F. AMPL V501 6BJ6
2D I.F. AMPL V502 6BJ6
3D I.F. AMPL V503 6BJ6
4TH I.F. AMPL V504 6BJ6
5TH I.F. AMPL V505 6BJ6
6TH I.F. AMPL V505 6AK6
455 KC
TB101
DIODE LOAD
14 15
DETECTOR V507A (1/2)12AU7
AUDIO SIGNAL
452 TO 458 KC
B+ VOLTAGE
LIMITER
OFF
NEGATIVE PEAK LIMITER V507B (1/2)12AU7
POSITIVE PEAK LIMITER V510B (1/2)12AU7
AF AMPL V601 (1/2)12AU7
LOCAL AF AMPL V602A (1/2)12AT7
LOCAL AF OUTPUT TUBE V603 6AK6
PHONES 5MW 600 OHMS
500MW 600 OHMS
SIDE-TONE INPUT
LINE AF AMPL V602B (1/2)12AT7
LINE AF OUTPUT TUBE V604 6AK6
BALANCED LINE 10 MW 600 OHMS
BFO V508 5749
ON
OFF
BFO
B+ VOLTAGE
SQUELCH TUBE V601B (1/2)12AU7
SQUELCH RELAY K601
TO REMOTE CONTROL J105K
BREAK-IN RELAY K602
FUNCTION
SQUELCH
B+ VOLTAGE
TO POWER SUPPLY PP-621/URR
TB102
AGC
NOR
FUNCTION
AGC
TO CONTROL GRID CIRCUITS OF V201, V202, V501, AND V505
AGC
SLOW
MED
FAST
AGC AMPL V509 6BJ6
AGC RECTIFIER V510A (1/2)12AU7
AGC TIME CONSTANT CIRCUIT AND TUBE V511A (1/2)12AU7
CATHODE FOLLOWER V511B (1/2)12AU7
J106 I F OUTPUT 50 OHMS
6 VOLTS DC TO BREAK-IN AND ANTENNA RELAYS
25.2 VOLTS AC TO FILAMENTS AND OVEN HEATERS
POWER SUPPLY PP-621/URR V801 26Z5W V802 26Z5W
VOLTAGE REGULATOR V605 6082 V606 6082
VOLTAGE REFERENCE TUBES V608 5651 V609 5651
REGULATED B+ 180V DC
DC AMPL V607 6BH6
115/230 VOLTS AC 48-62 CPS
TM647-34
436794 O - 57 (Face p. 58)
331894 O - 55 (Face p. 58)

Figure 36. Radio Receiver R-390/URR, block diagram.

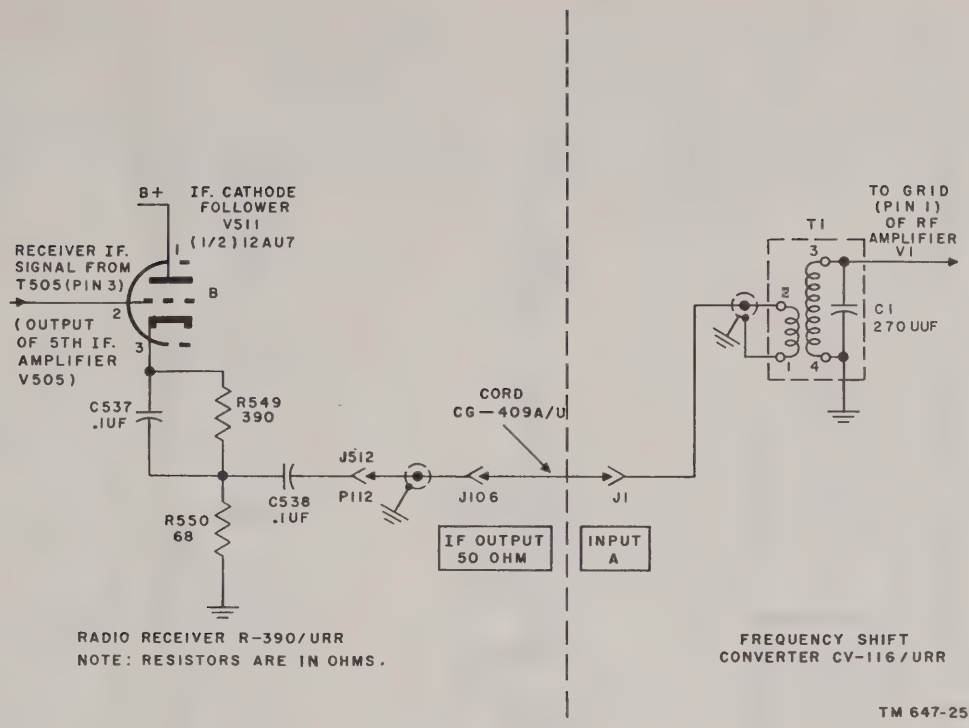


Figure 37. Radio Receiver R-390/URR if output circuit and Frequency Shift Converter CV-116/URR input circuit.

f. The 455 kc if input signal from the receiver is inductively coupled through T1 in the converter and fed to the control grid of rf amplifier V1. Similar circuits in channel B, employing receptacle J5, inductor T3, and rf amplifier V27 perform the same function for channel B that J1, T1, and V1 perform in channel A.

60. Frequency Shift Converter CV-116/URR Block Diagram

(fig. 38)

The frequency-shift converter consists of frequency converters, limiter amplifiers and clippers, discriminators, an afc circuit, a keyer circuit, a dc output circuit, and a mark-hold circuit. In addition to meters provided as an aid in ordinary operation, a special metering circuit has been included to enable additional tests of the circuit of the converter without external testing devices or disassembly of the component.

a. The 455 kc if output of one receiver is connected to INPUT A of the converter and the 455 kc if output of the other receiver to INPUT B. Each input circuit amplifies the signal and converts it to a lower if. The two frequency-shift signals, now operating at lower if frequencies, are fed to the diversity circuits, where they are amplified, limited and combined. The resultant frequency-shift signal is then converted into dc pulses which are used to control the operation of a receiving teletypewriter. In this manner, optimum signals are obtained from diversity reception.

b. In addition to the signal delivered to the diversity circuits, if output from each mixer stage is also applied to a separate discriminator circuit which demodulates the signal for use in the operation of an afc circuit. There is a separate afc circuit for each channel. Each afc circuit controls a phase actuated motor which is mechanically coupled to a variable capacitor forming part of the tank circuit of the heterodyne oscillator. The motor operates to hold the heterodyne input signal at the converter if and thus compensates for minor frequency variations that originate in the transmitter, the receiver, or in the converter itself. In addition to afc, the operator may place the converter in crystal control operation or manually tuned vfo operation, in which case the afc circuit is not used.

c. The mark-hold circuit automatically applies a steady marking signal to the receiving teletypewriter in the event that the incoming signal fades below a usable level.

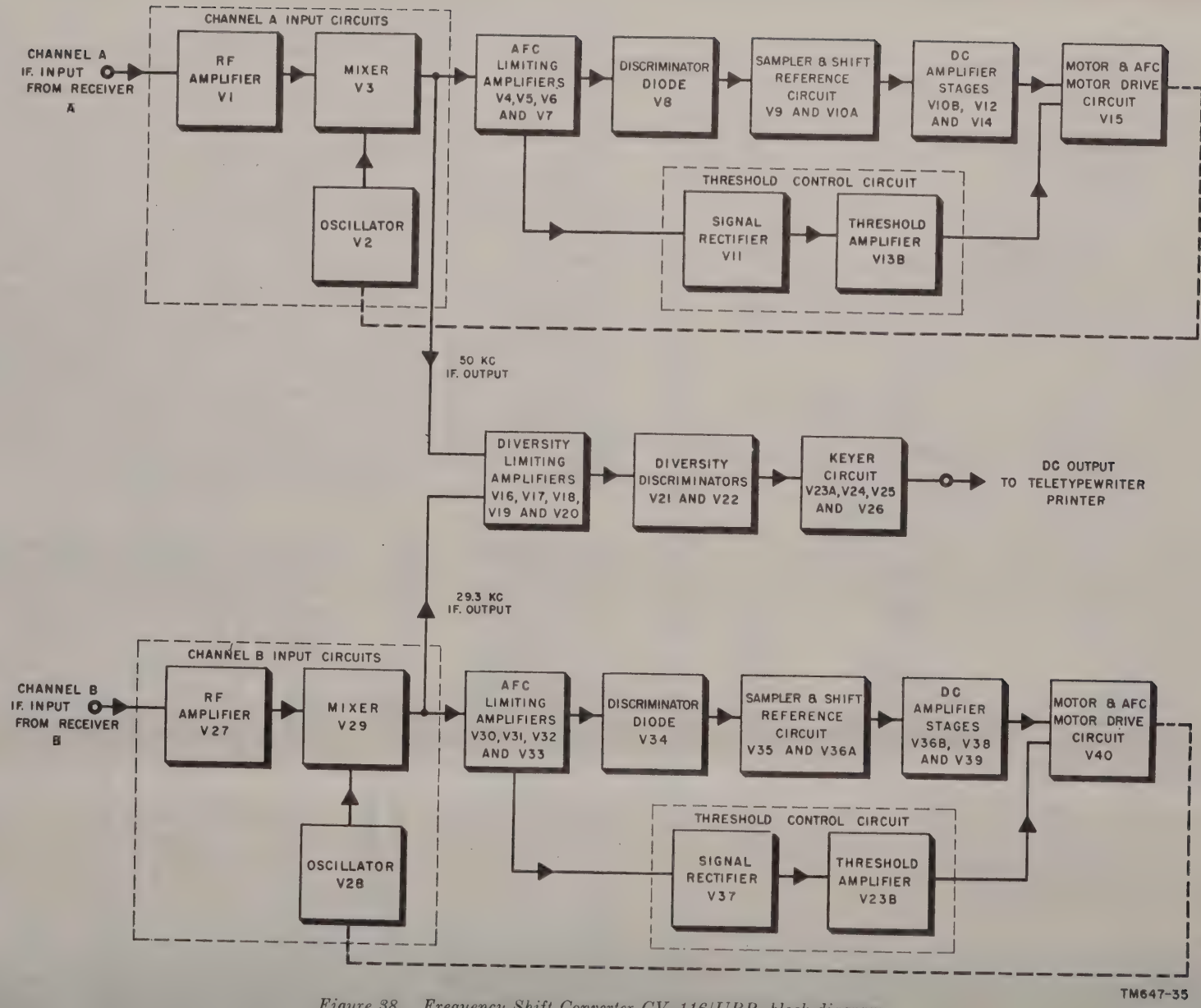


Figure 38. Frequency Shift Converter CV-116/URR, block diagram.

d. In single channel operation, the channel of the converter that receives the input is operative. In this type of operation, the output of the converter mixer is delivered to the diversity and afc circuits in the usual way, and is demodulated in the diversity discriminator and used to operate the keyer and dc output circuits.

61. Electrical Equipment Cabinet CY–1119/U

The electrical equipment cabinet has been fused and wired with convenience outlets to provide power to the receiver and converter components mounted in it. A schematic of the cabinet wiring is shown in figure 41.

CHAPTER 5

SYSTEM FIELD MAINTENANCE

Note. This chapter contains information for system field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited by the tools and test equipment available, and by the skill of the repairman.

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

62. Troubleshooting Procedures

a. General. The first step in servicing a defective receiving set is to sectionalize the fault. Sectionalization means tracing the fault to the major component responsible for the abnormal operation of the receiving set. The second step is to localize the fault. Localization means tracing the fault to the defective item responsible for the abnormal condition. This chapter will be concerned only with system maintenance; that is, with tracing the trouble to a particular component. When the trouble has been isolated, the repairman should then refer to the technical manual that covers the faulty component.

b. System Sectionalization. The receiving set should be set up for operation following the steps given in the procedure for diversity operation (par. 27). Check the operation of the components against the equipment performance check list (par. 54), until an abnormal indication is noted. Refer to the system troubleshooting chart (par. 67), which will often indicate the item causing the trouble and the corrective measures to be taken. If the charts do not give sufficient information, the trouble must be localized within the defective component.

c. Localization. Localization is the tracing of an equipment fault to a particular item. Localization of trouble within a component of the receiving set may be accomplished by following instructions in the receiver and converter technical manuals furnished with the equipment.

63. Troubleshooting Data

Material contained in this manual will aid in the rapid sectionalization of faults. Utilize the technical manuals furnished with the individual components that make up the equipment for detailed information about the receivers and converter.

References		Description
Fig.	Par.	
	35	Calibration of R–390/URR frequency indicator.
	54	Equipment performance check list.
	67	System troubleshooting chart.
	69	Signal substitution.
16 & 17		Radio Receiver R–390/URR, tube locations.
18		Radio Receiving Set AN/FRR–38, cording diagram.
42		Radio Receiver R–390/URR, schematic diagram.
15		Frequency Shift Converter CV–116/URR, tube locations.
39		Resistor color codes.
40		Capacitor color codes.
43		Frequency Shift Converter CV–116/URR, schematic diagram.
41		Electrical Equipment Cabinet CY–1119/U, schematic and wiring diagram.
44		Radio Receiving Set AN/FRR–38, cabling diagram.

64. Test Equipment Required for Troubleshooting

The test equipment required for testing the receiving set includes a tube tester such as Electron Tube Tester TV–2/U. Test equipment required for troubleshooting the individual units is listed in the manuals covering the receiver and the converter.

65. Checking Tubes

a. Tube Failures. Tube failures are responsible for a large percentage of the faults that occur in a radio set. Do not attempt to find the source of trouble in the receiving set by indiscriminately changing tubes.

b. Tube Checking. Tube checkers are used to check either the emission or the mutual conductance of a tube and to test for shorted elements within the tube. Remember that the results obtained from the tube checker are not obtained under the same conditions as those under which the tube operates in the receiving set. For this reason, the final test of a tube must be a substitution in the receiving set with a tube that is known to be good.

66. Operational Test

a. If the item of equipment being repaired is installed as part of the receiving set, operate the equipment in accordance with the equipment performance check list in paragraph 54. The check list frequently indicates the general location of trouble. Refer to the system troubleshooting chart in paragraph 67 to locate a possible source of trouble. More detailed information can be obtained from the individual manuals supplied with the equipment.

b. If the equipment is being checked individually, follow the troubleshooting procedure described in the individual equipment manual.

67. System Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in the receiving set. This chart lists the symptoms which the repairman may observe while operating the equipment. The starting procedure described in paragraph 27 should be followed.

Symptom	Probable trouble	Correction
1. No dial lamps light, equipment completely inoperative when power switches are turned ON.	Trouble at power source.	Check power source and interconnection cables.
	Line switch S1001 (fig. 41) in OFF position.	Turn S1001 ON.
	F1101 and/or F1102 burned out-----	Replace F1101 and/or F1102. If fuses immediately blow upon replacement, disconnect power source and make continuity check between sockets of F1101 and F1102, while, one at a time, disconnecting components from cabinet receptacle strip to discover shorted component.
2. Dial lamp on one receiver fails to light when FUNCTION switch is turned from OFF position.	Receiver not properly connected to receptacle strip in cabinet.	Check connections of receiver to cabinet receptacle strip.
	AC3A fuse (receiver F101) burned out.	Replace AC3A fuse at receiver rear panel.
3. Receiver dial lamp lights, but CARRIER LEVEL meter does not deflect. No reception with RF and LOCAL GAIN controls at 10.	No B+ voltage. B+ 3/8A fuse (receiver F102) burned out.	Replace B+ 3/8A fuse at receiver rear panel. If fuse blows out once more, refer to TM 11–856.
4. No beat frequency is heard when BFO switch is turned ON.	Defective bfo.	Test receiver tube V508. Refer to TM 11–856 to check for proper voltages at socket pins of this tube.
5. Converter pilot lamp does not light when receiver dial lamps do.	Converter improperly connected to receptacle strip in cabinet.	Check connection of converter to cabinet receptacle strip.
	Converter line fuse (F1 and/or F2) burned out.	Replace F1 and/or F2 on rear panel. If fuses blow out upon replacement, refer to the converter manual.

Symptom	Probable trouble	Correction
6. Converter SIGNAL INPUT meter does not show any input level from receiver, in either Channel A or Channel B.	Receiver improperly tuned.	Check receiver tuning (par. 27).
	Receiver RF GAIN control set too low.	Advance receiver RF GAIN control until reading is obtained on converter SIGNAL INPUT meter.
	Cable connecting receiver IF OUTPUT (J106) to converter INPUT A or B (J1 or J5) improperly connected.	Check if interconnecting cabling.
	Receiver if output circuit faulty.	Check receiver if output circuit (V511B and associated components) using TM 11–856 voltage and resistance charts as guides.
	Converter input circuit faulty.	Check converter input circuit (V1 for Channel A and V27 for Channel B) and associated circuitry using the converter manual voltage and resistance charts as guides.
7. Converter DISCRIMINATOR meter does not track keying in one or both channels when SIGNAL INPUT meter is peaked.	Incorrect tuning procedure followed.	Tune equipment correctly (par. 27). Check paragraph 28 to make certain proper procedure for type of operation being used is being followed.
	Receiver BANDWIDTH control set to .1 KC.	Set receiver BANDWIDTH control to 1 KC.
	Converter discriminator or limiting circuits failure.	Consult the converter manual for troubleshooting procedure for these stages.
8. AFC INDICATOR does not move, converter does not track frequency drifts.	Wrong tuning procedure followed for afc operation.	Set converter properly for afc operation (par. 31).
	Converter afc circuit failure.	Consult the converter manual for detailed localization procedure for tracing fault in afc circuit.
9. Receiving set operating properly but teletypewriter equipment does not print.	Converter output connections improperly made.	Check converter output connections (fig. 18).
	Failure in teletypewriter control unit.	Check operation of control unit using applicable technical manual.
10. Receiving set operating properly but teletypewriter prints garbled copy.	Converter AFC THRESHOLD LEVEL control set improperly.	Reset AFC THRESHOLD LEVEL control (par. 28*e*).
	Converter loop current adjustment set improperly.	Readjust loop current (par. 25*b*).

68. Component Troubleshooting

After a fault in Radio Receiving Set AN/FRR–38 has been sectionalized to a component by following the system troubleshooting chart (par. 67), the particular item or component causing the fault must be localized. Detailed troubleshooting procedures for these components will be found in individual manuals.

69. Signal Substitution

A defective component or stage may often be localized quickly by substitution of input and output signals within the receiving set. It is improbable that both receivers will fail simultaneously. For this reason, it is possible to connect the if output of receiver A to the converter INPUT B receptacle to determine whether the indicated failure exists in receiver B or in the converter channel B circuits. The technician will, as he grows more familiar with the equipment, find further experiments of this kind that will be very useful in sectionalizing failures in the equipment.

Section II. Repairs

70. Refinishing

Instructions for the refinishing of badly marred panels, cabinets, and cases are available in TM 9–2851.

71. Alinement and Adjustment Procedures

Detailed alinement and adjustment instructions for the receivers and the converter are given in TM 11–856 and the converter manual.

72. Final Testing

Each component of the receiving set which has been repaired should be final tested in accordance with the final testing procedures given in the individual manuals. Any component passing the tests is suitable for field use. Failure of the component to perform according to these tests indicates that more trouble shooting is necessary. A suitable final test for the assembled equipment is to operate it according to the equipment performance check list given in paragraph 54.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

73. General

The exact procedure for shipment or limited storage depends upon the material available and the conditions under which the equipment is to be shipped or stored.

74. Disassembly for Shipment or Limited Storage

When disassembling Radio Receiving Set AN/FRR–38 for shipment or limited storage, disconnect and remove all interconnecting cables from the components and remove the components from the cabinet. Refer to the packaging data in paragraph 7 for the number of packing cases necessary and the items to be packed in each case. Remove the blank panels from the cabinet and replace the plate covers on the access openings at the sides and top of the cabinet. Remove the fuses from the cabinet switch box.

75. Repacking for Shipment or Limited Storage

Repack the cabinet and installation kit using figures 12 and 13 as guides. Refer to paragraph 16 and reverse the instructions given in that paragraph. Whenever practicable, place a dehydrating agent such as silica gel inside the cardboard cartons. Protect the cartons with a waterproof barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected cartons in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the wooden packing case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

76. General

The demolition procedures outlined in paragraph 77 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon the order of the commander.

77. Methods of Destruction

a. Smash. Smash the crystals, controls, tubes, coils, motors, switches, capacitors, and transformers; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cables and wiring; use axes, handaxes, or machetes.

c. Burn. Burn cables, resistors, capacitors, coils, wiring, and manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinet, and chassis.

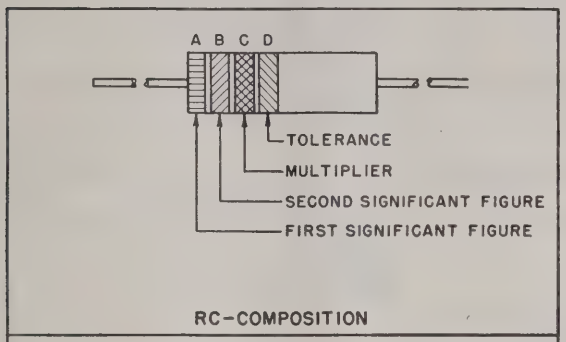
e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

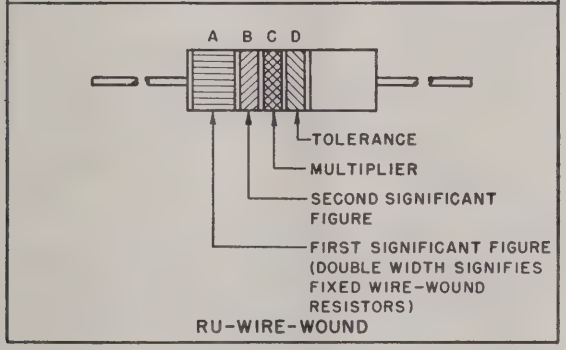
g. Destroy. Destroy everything.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)

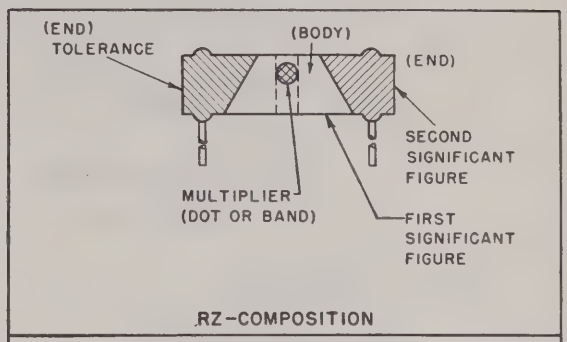


RC-COMPOSITION

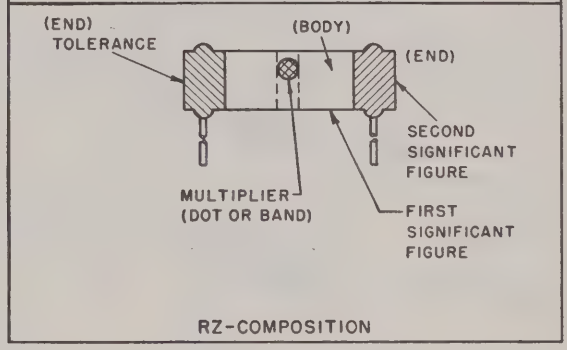


RU-WIRE-WOUND

RADIAL-LEAD RESISTORS (UNINSULATED)



RZ-COMPOSITION



RZ-COMPOSITION

RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	±20
BROWN	1	BROWN	1	BROWN	10	SILVER	±10
RED	2	RED	2	RED	100	GOLD	±5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

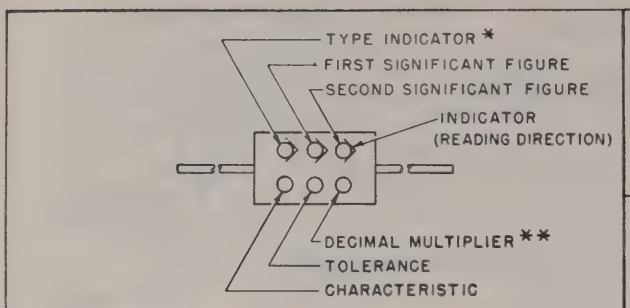
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI
ARMY FT MON N. J.

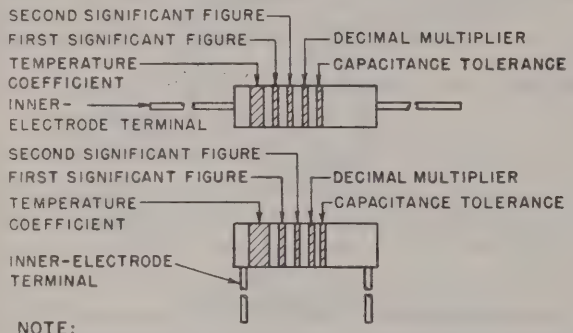
Figure 39. Resistor color codes.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



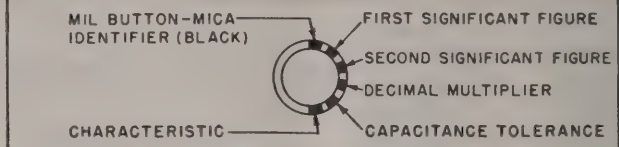
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)

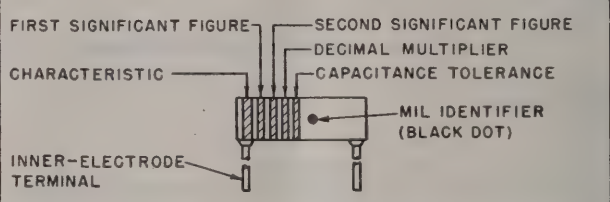


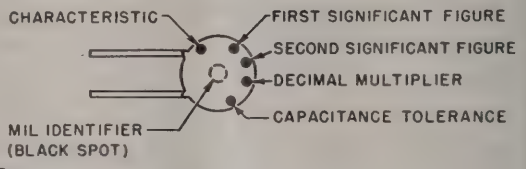
NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



BUTTON-MICA (CB)





NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI
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Figure 40. Capacitor color codes.

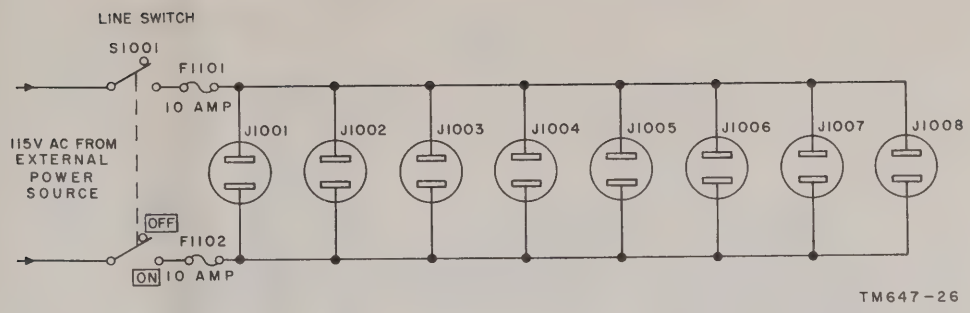


Figure 41. Electrical Equipment Cabinet CY–1119/U, schematic diagram.

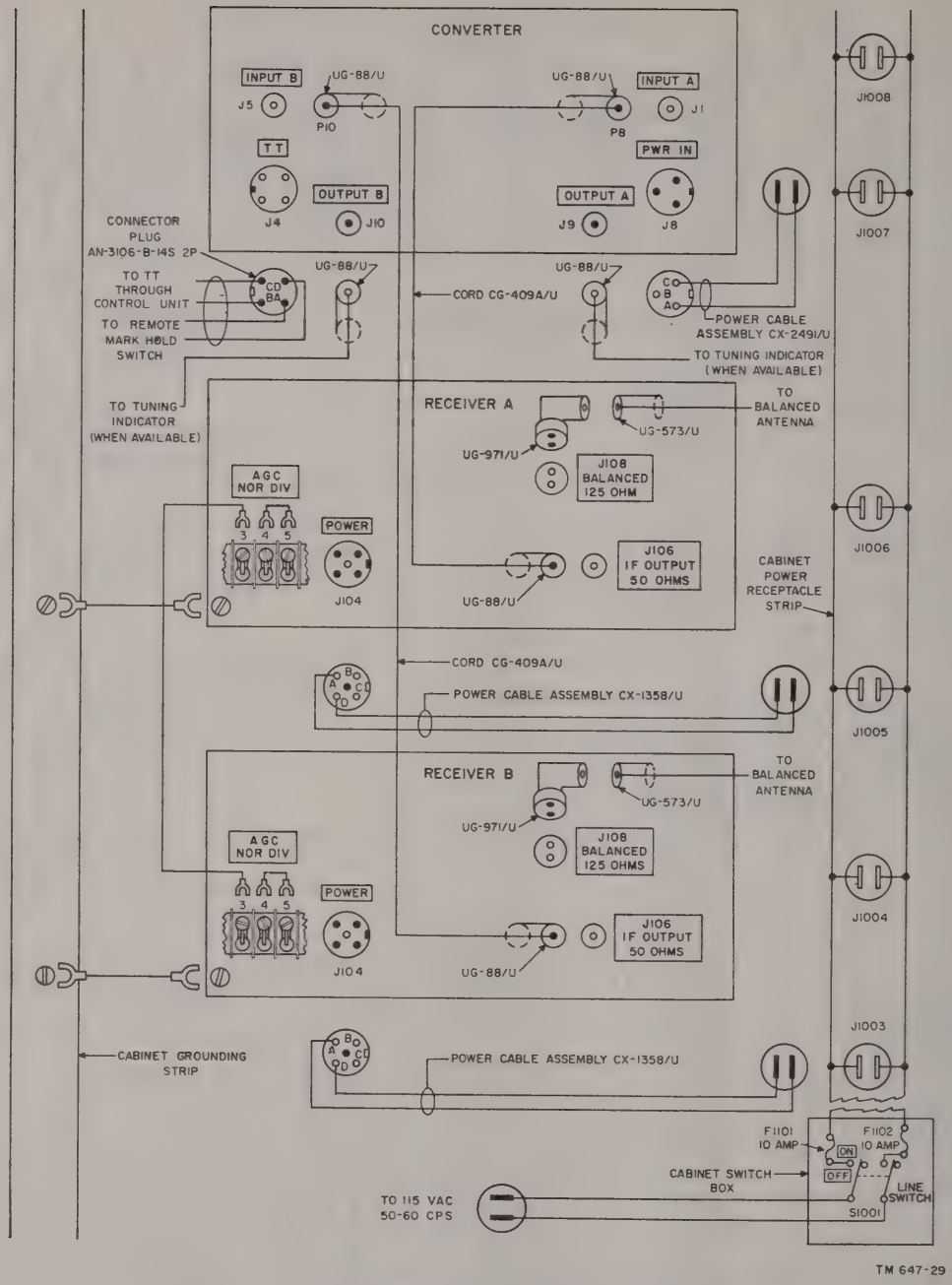
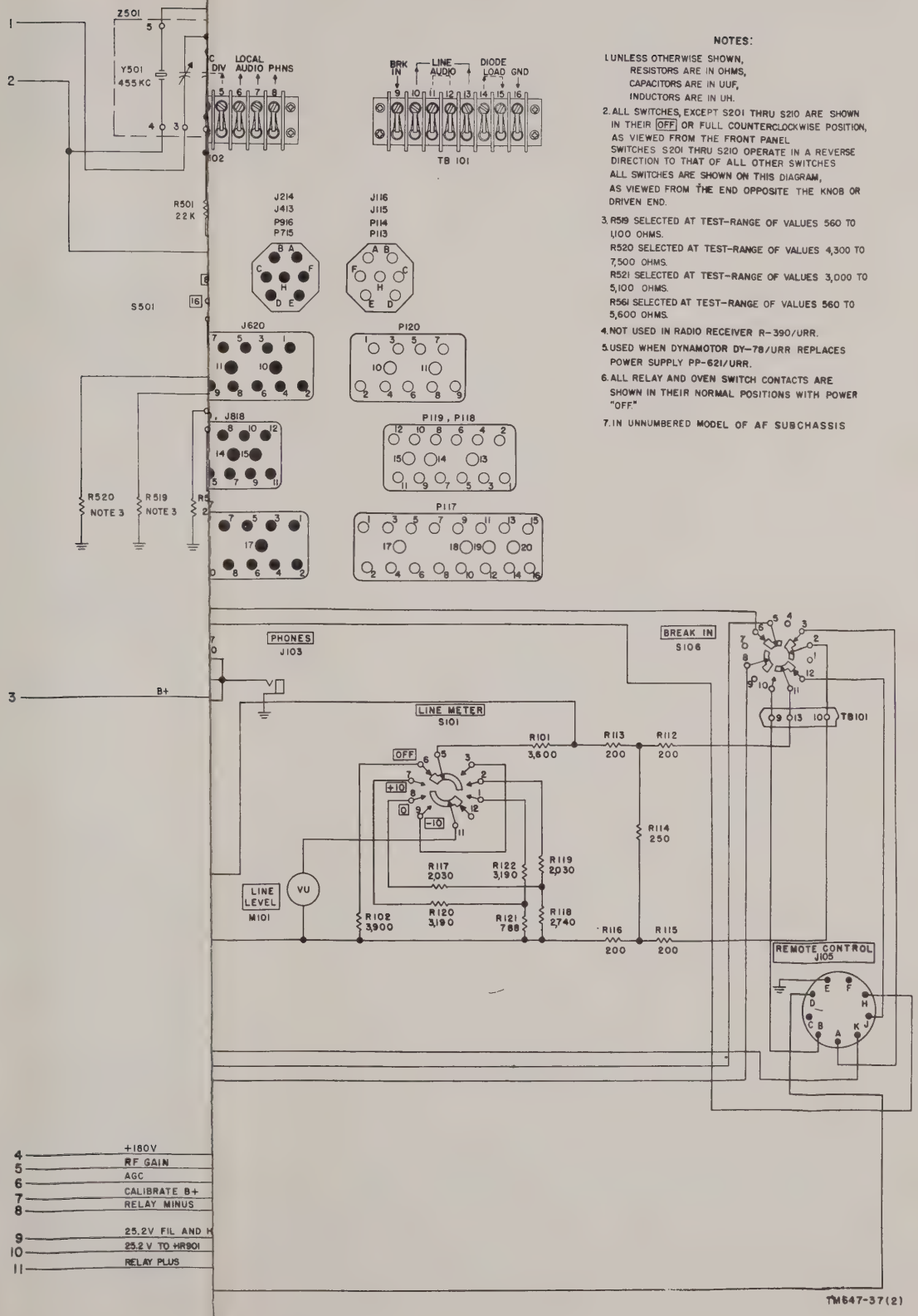


Figure 44. Radio Receiving Set AN/FRR–38, cabling diagram.


NOTES:
1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF, INDUCTORS ARE IN UH.
2. ALL SWITCHES, EXCEPT S201 THRU S210 ARE SHOWN IN THEIR OFF OR FULL COUNTERCLOCKWISE POSITION, AS VIEWED FROM THE FRONT PANEL. SWITCHES S201 THRU S210 OPERATE IN A REVERSE DIRECTION TO THAT OF ALL OTHER SWITCHES. ALL SWITCHES ARE SHOWN ON THIS DIAGRAM, AS VIEWED FROM THE END OPPOSITE THE KNOB OR DRIVEN END.
3. R519 SELECTED AT TEST-RANGE OF VALUES 560 TO 1,100 OHMS.
R520 SELECTED AT TEST-RANGE OF VALUES 4,300 TO 7,500 OHMS.
R521 SELECTED AT TEST-RANGE OF VALUES 3,000 TO 5,100 OHMS.
R561 SELECTED AT TEST-RANGE OF VALUES 560 TO 5,600 OHMS.
4. NOT USED IN RADIO RECEIVER R-390/URR.
5. USED WHEN DYNAMOTOR DY-78/URR REPLACES POWER SUPPLY PP-621/URR.
6. ALL RELAY AND OVEN SWITCH CONTACTS ARE SHOWN IN THEIR NORMAL POSITIONS WITH POWER "OFF."
7. IN UNNUMBERED MODEL OF AF SUBCHASSIS
Z501
Y501
455 KC
LOCAL AUDIO PHNS
DIV
TB 102
BRK IN
LINE AUDIO
DIODE LOAD
GND
TB 101
R501
22K
S501
J214
J413
P916
P715
J116
J115
P114
P113
J620
P120
J818
P119, P118
P117
R520
NOTE 3
R519
NOTE 3
PHONES
J103
B+
LINE METER
S101
R101
3,600
R113
200
R112
200
OFF
+10
0
-10
R114
250
R117
2,030
R122
3,190
R119
2,030
R120
3,190
R121
788
R118
2,740
R102
3,900
R116
200
R115
200
LINE LEVEL
M101
VU
BREAK IN
S106
TB101
REMOTE CONTROL
J105
4 +180V
5 RF GAIN
6 AGC
7 CALIBRATE B+
8 RELAY MINUS
9 25.2V FIL AND H
10 25.2 V TO HR901
11 RELAY PLUS
TM647-37(2)
436794 O-57 (Face p. 70) No. 1

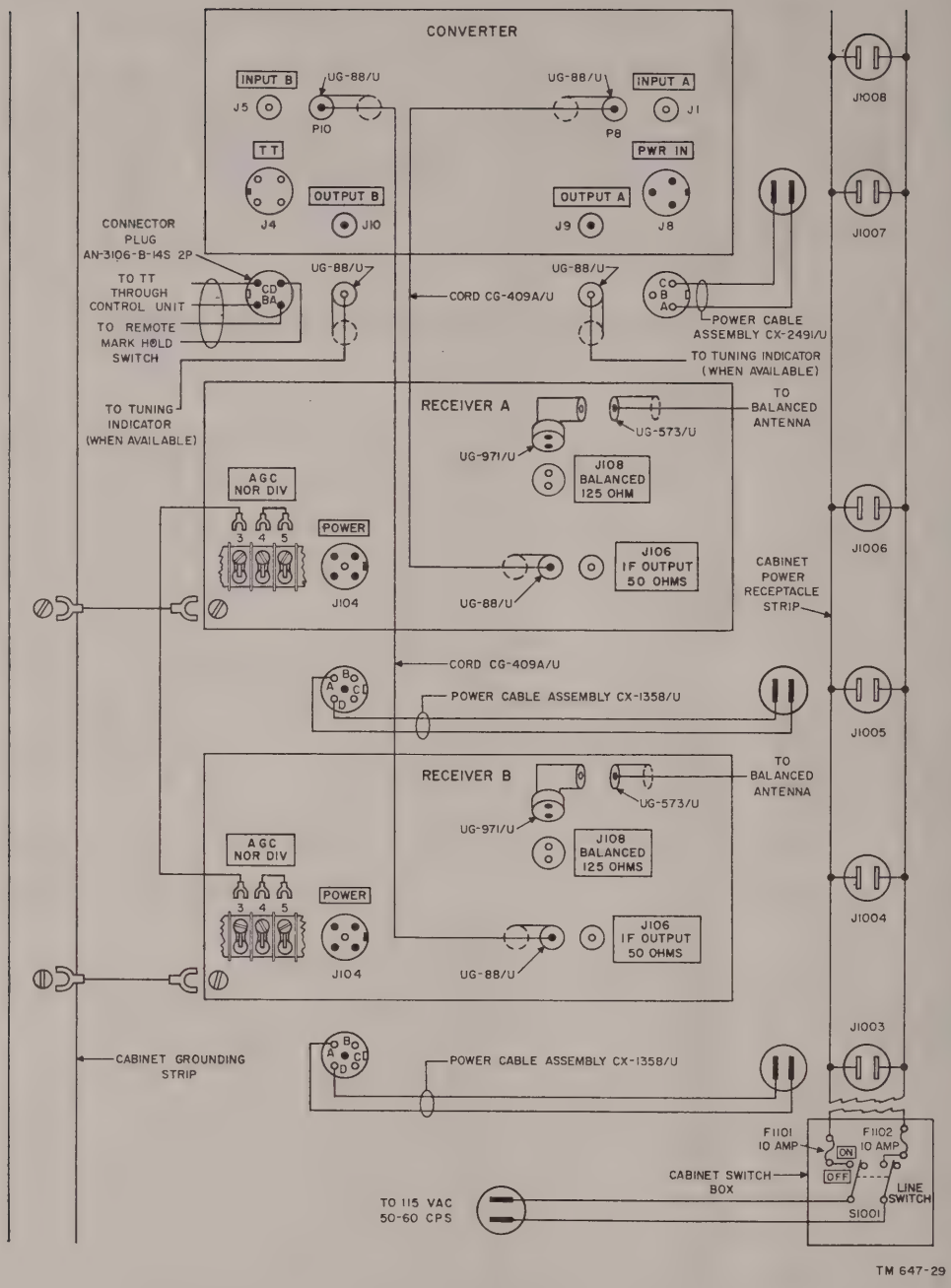
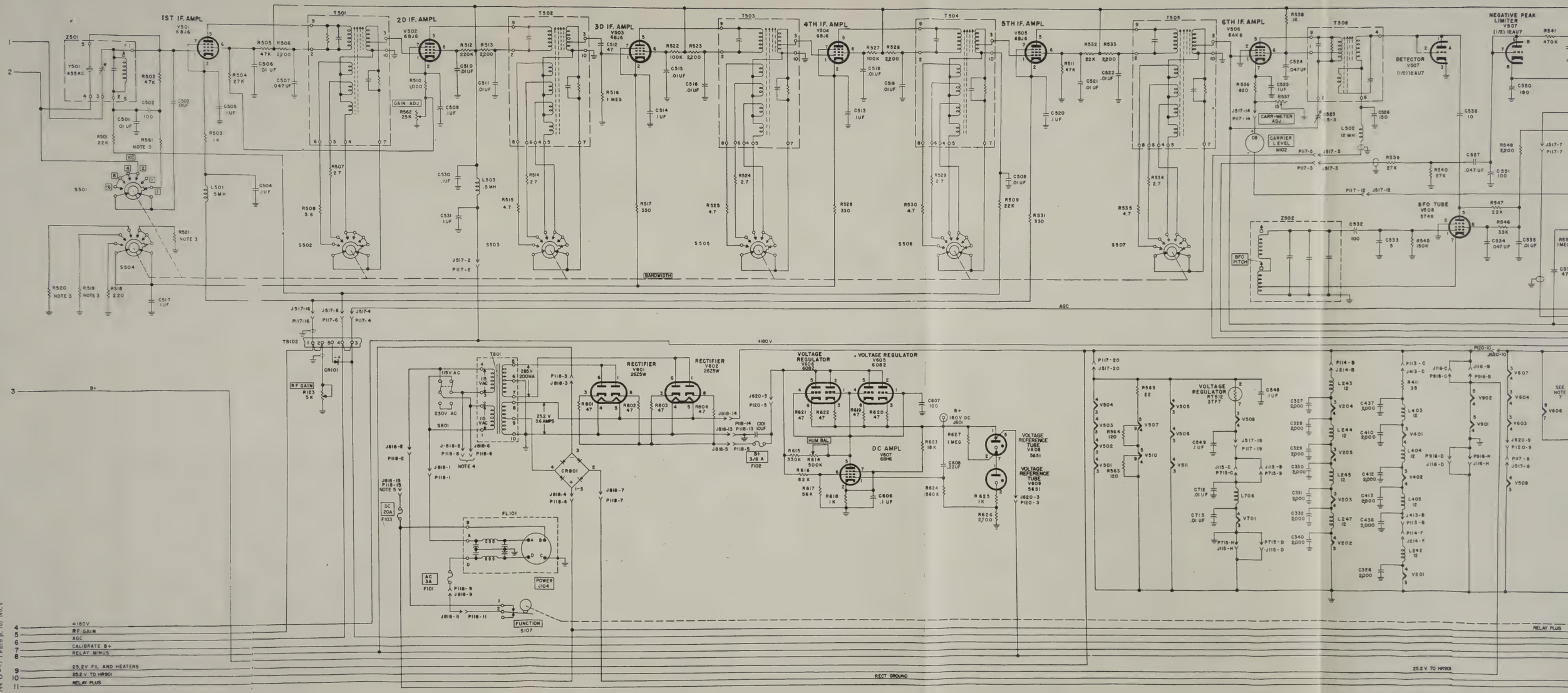
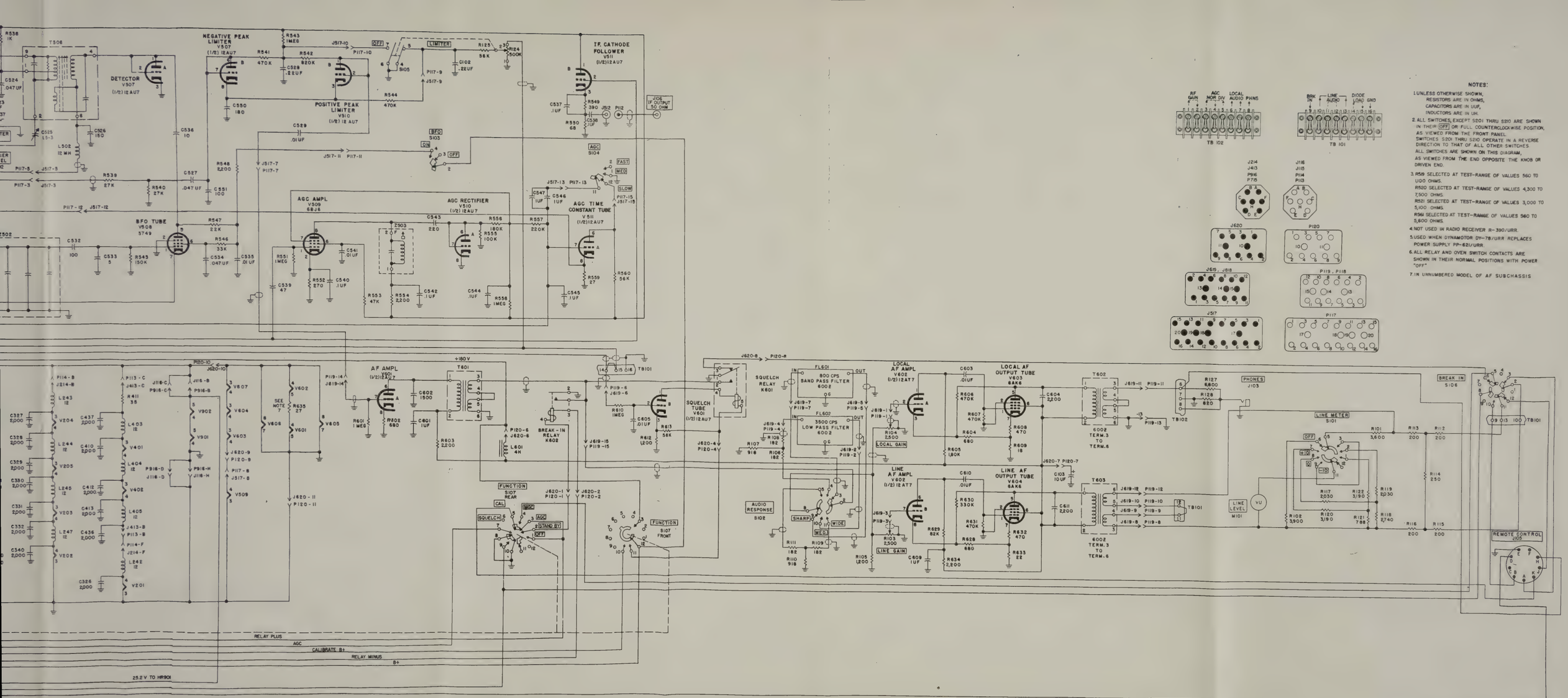


Figure 44. Radio Receiving Set AN/FRR–38, cabling diagram.



436794 O—47 (Face p. 70) No. 1

Figure 42. Radio Receiver R-390/URR, schematic diagra

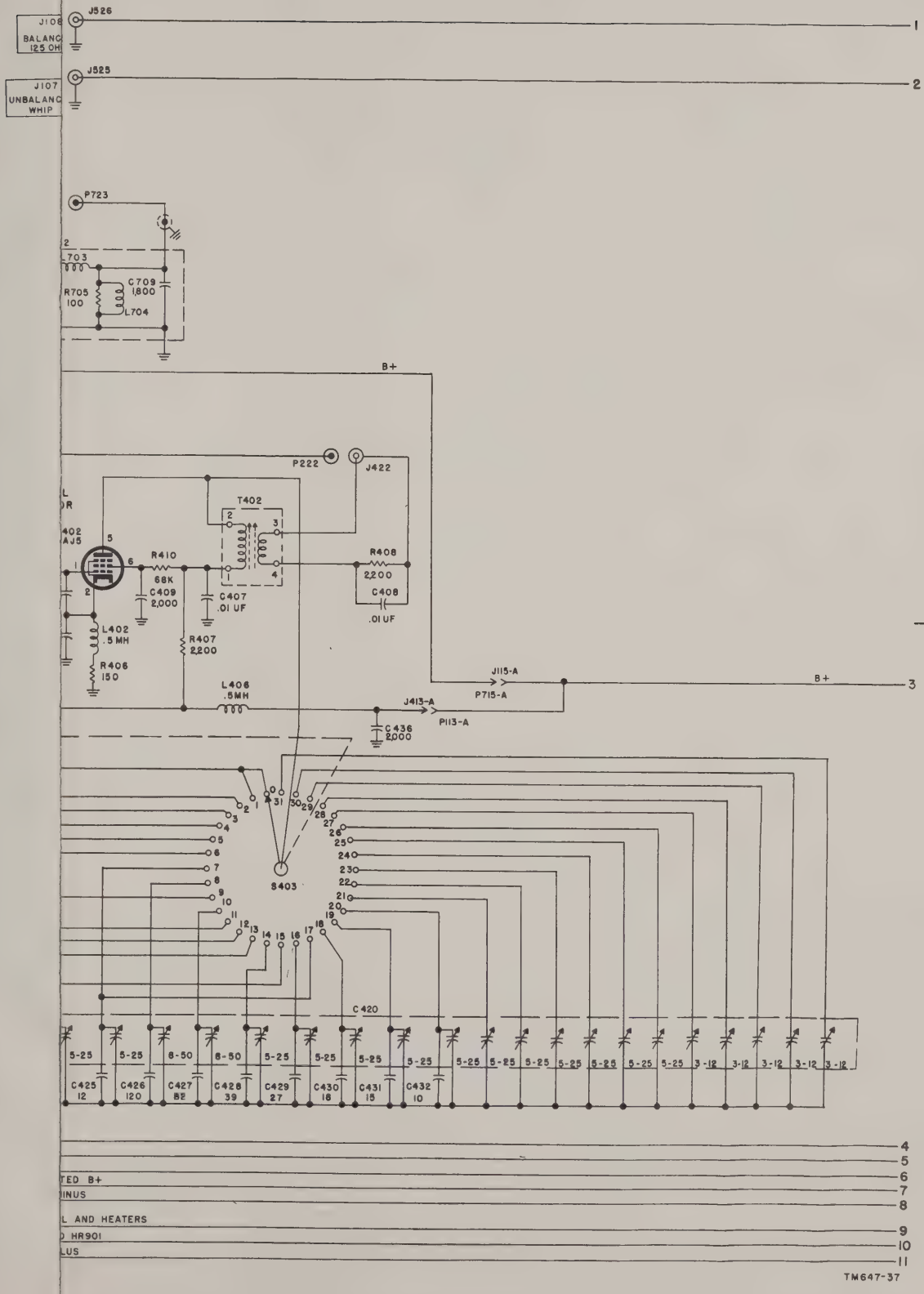


NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF, INDUCTORS ARE IN UH.
2. ALL SWITCHES, EXCEPT S201 THRU S210 ARE SHOWN IN THEIR OFF OR FULL COUNTERCLOCKWISE POSITION, AS VIEWED FROM THE FRONT PANEL. SWITCHES S201 THRU S210 OPERATE IN A REVERSE DIRECTION TO THAT OF ALL OTHER SWITCHES. ALL SWITCHES ARE SHOWN ON THIS DIAGRAM, AS VIEWED FROM THE END OPPOSITE THE KNOB OR DRIVEN END.
3. R59 SELECTED AT TEST-RANGE OF VALUES 560 TO 1,020 OHMS.
   R520 SELECTED AT TEST-RANGE OF VALUES 4,300 TO 7,500 OHMS.
   R521 SELECTED AT TEST-RANGE OF VALUES 3,000 TO 5,100 OHMS.
   R561 SELECTED AT TEST-RANGE OF VALUES 560 TO 5,600 OHMS.
4. NOT USED IN RADIO RECEIVER R-390/URR.
5. USED WHEN DYNAMOTOR DY-78/URR REPLACES POWER SUPPLY PP-621/URR.
6. ALL RELAY AND OVEN SWITCH CONTACTS ARE SHOWN IN THEIR NORMAL POSITIONS WITH POWER "OFF".
7. IN UNNUMBERED MODEL OF AF SUBCHASSIS

TM847-37(2)

Figure 42. Radio Receiver R-390/URR, schematic diagram


J526
J525
P723
L703
R705
100
C709
1,800
L704
B+
P222
J422
T402
R410
68K
C409
2,000
C407
.01 UF
R408
2200
C408
.01 UF
L402
.5 MH
R407
2200
R406
150
L406
.5MH
J115-A
P715-A
J413-A
P113-A
C436
2,000
S403
C420
5-25
8-50
3-12
C425
12
C426
120
C427
82
C428
39
C429
27
C430
18
C431
15
C432
10
B+
3
4
5
6
7
8
9
10
11
TM647-37

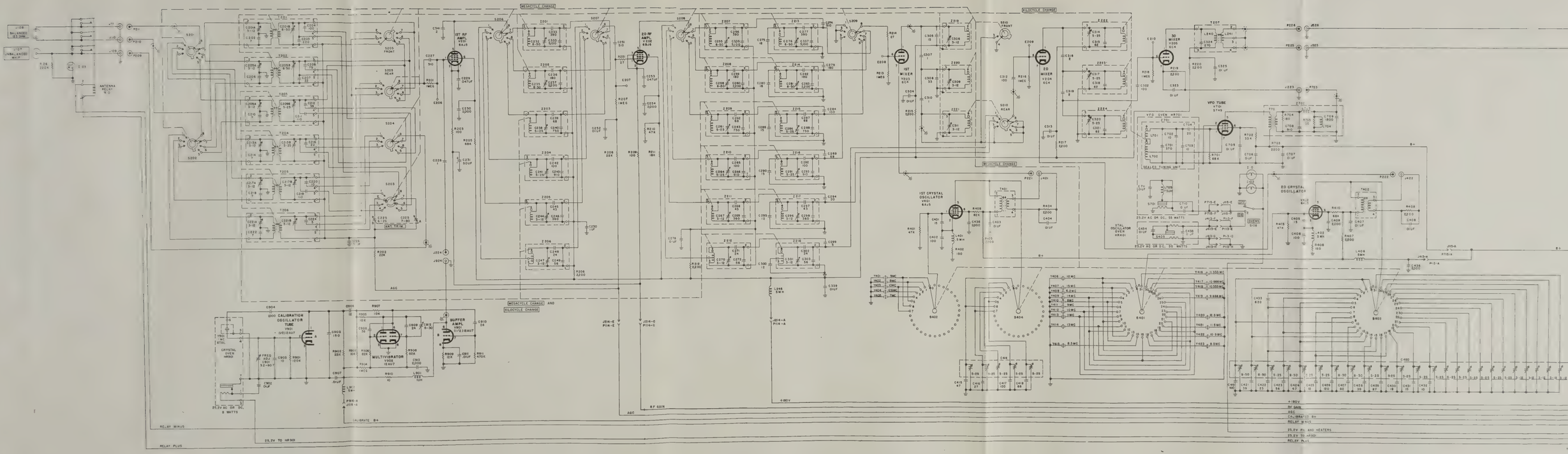
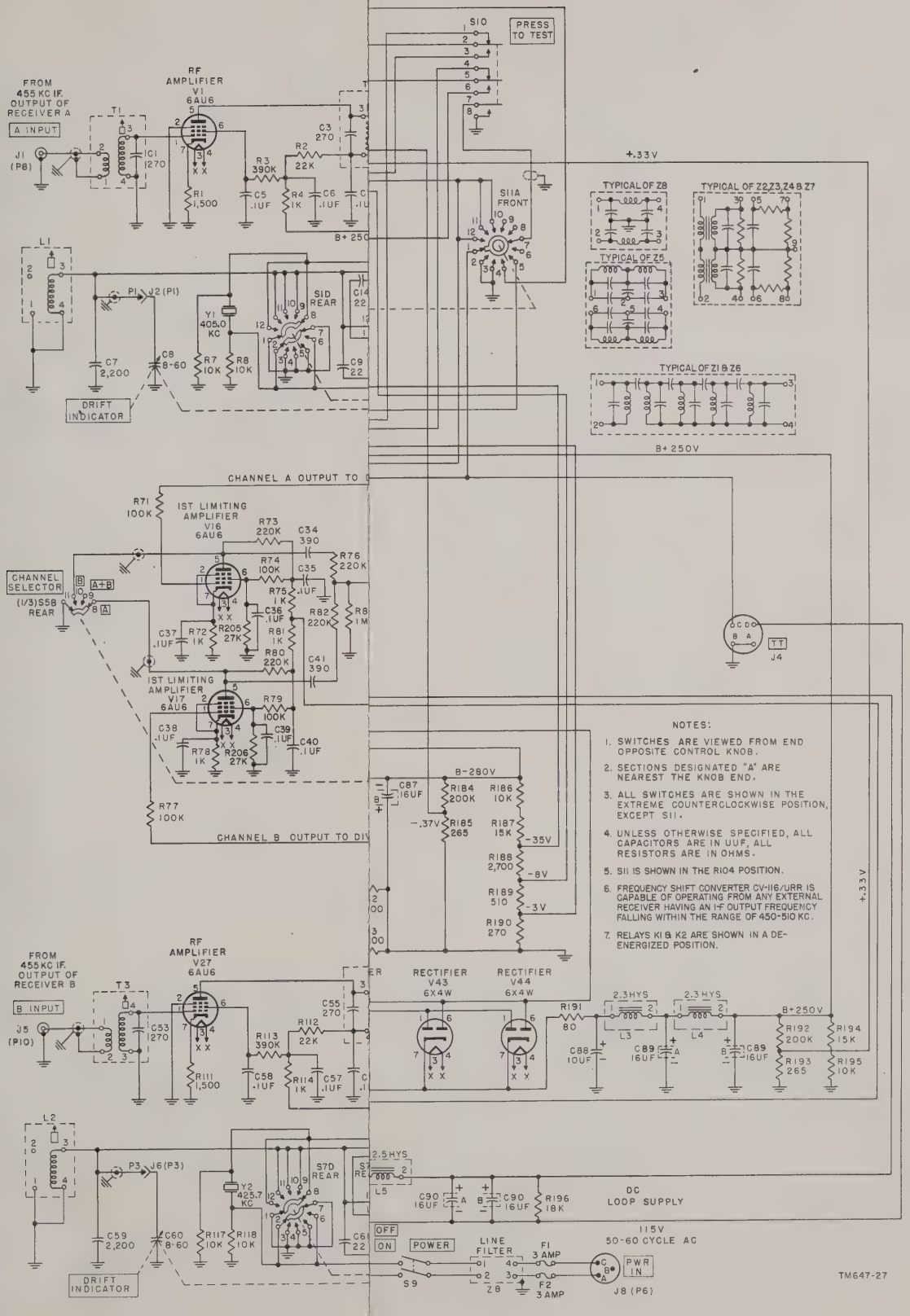


Figure 42. Radio Receiver R-390/URR, schematic diagram. —Continued.


FROM 455 KC IF. OUTPUT OF RECEIVER A
A INPUT
J1 (P8)
T1
C1 270
RF AMPLIFIER V1 6AU6
R1 1,500
R2 22K
R3 390K
R4 1K
C3 270
C5 .1UF
C6 .1UF
B+ 250
S10
PRESS TO TEST
+.33V
S11A FRONT
TYPICAL OF Z8
TYPICAL OF Z2,Z3,Z4 & Z7
TYPICAL OF Z5
TYPICAL OF Z1 & Z6
L1
P1
J2 (P1)
Y1 405.0 KC
S10 REAR
C7 2,200
C8 8-60
R7 10K
R8 10K
DRIFT INDICATOR
B+250V
CHANNEL A OUTPUT TO
R71 100K
1ST LIMITING AMPLIFIER V16 6AU6
R73 220K
C34 390
R74 100K
C35 .1UF
R76 220K
CHANNEL SELECTOR
(1/3)S5B REAR
B
A+B
A
C36 .1UF
R75 1K
R82 220K
R205 27K
R81 1K
R80 220K
C41 390
C37 .1UF
R72 1K
1ST LIMITING AMPLIFIER V17 6AU6
R79 100K
C38 .1UF
C39 .1UF
C40 .1UF
R78 1K
R206 27K
R77 100K
CHANNEL B OUTPUT TO DI
B-280V
C87 16UF
R184 200K
R186 10K
-.37V
R185 265
R187 15K
-35V
R188 2,700
-8V
R189 510
-3V
R190 270
NOTES:
1. SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.
2. SECTIONS DESIGNATED "A" ARE NEAREST THE KNOB END.
3. ALL SWITCHES ARE SHOWN IN THE EXTREME COUNTERCLOCKWISE POSITION, EXCEPT S11.
4. UNLESS OTHERWISE SPECIFIED, ALL CAPACITORS ARE IN UUF, ALL RESISTORS ARE IN OHMS.
5. S11 IS SHOWN IN THE R104 POSITION.
6. FREQUENCY SHIFT CONVERTER CV-116/URR IS CAPABLE OF OPERATING FROM ANY EXTERNAL RECEIVER HAVING AN I-F OUTPUT FREQUENCY FALLING WITHIN THE RANGE OF 450-510 KC.
7. RELAYS K1 & K2 ARE SHOWN IN A DE-ENERGIZED POSITION.
TT J4
FROM 455 KC IF. OUTPUT OF RECEIVER B
B INPUT
J5 (P10)
T3
C53 270
RF AMPLIFIER V27 6AU6
R111 1,500
R112 22K
R113 390K
R114 1K
C55 270
C58 .1UF
C57 .1UF
RECTIFIER V43 6X4W
RECTIFIER V44 6X4W
R191 80
2.3HYS
L3
L4
C88 10UF
C89 16UF
C89 16UF
B+250V
R192 200K
R193 265
R194 15K
R195 10K
L2
P3
J6(P3)
Y2 425.7 KC
S7D REAR
C59 2,200
C60 8-60
R117 10K
R118 10K
2.5HYS
L5
C90 16UF
C90 16UF
R196 18K
DC LOOP SUPPLY
DRIFT INDICATOR
OFF
ON
POWER
LINE FILTER
F1 3 AMP
F2 3 AMP
S9
Z8
115V 50-60 CYCLE AC
PWR IN
J8 (P6)
TM647-27

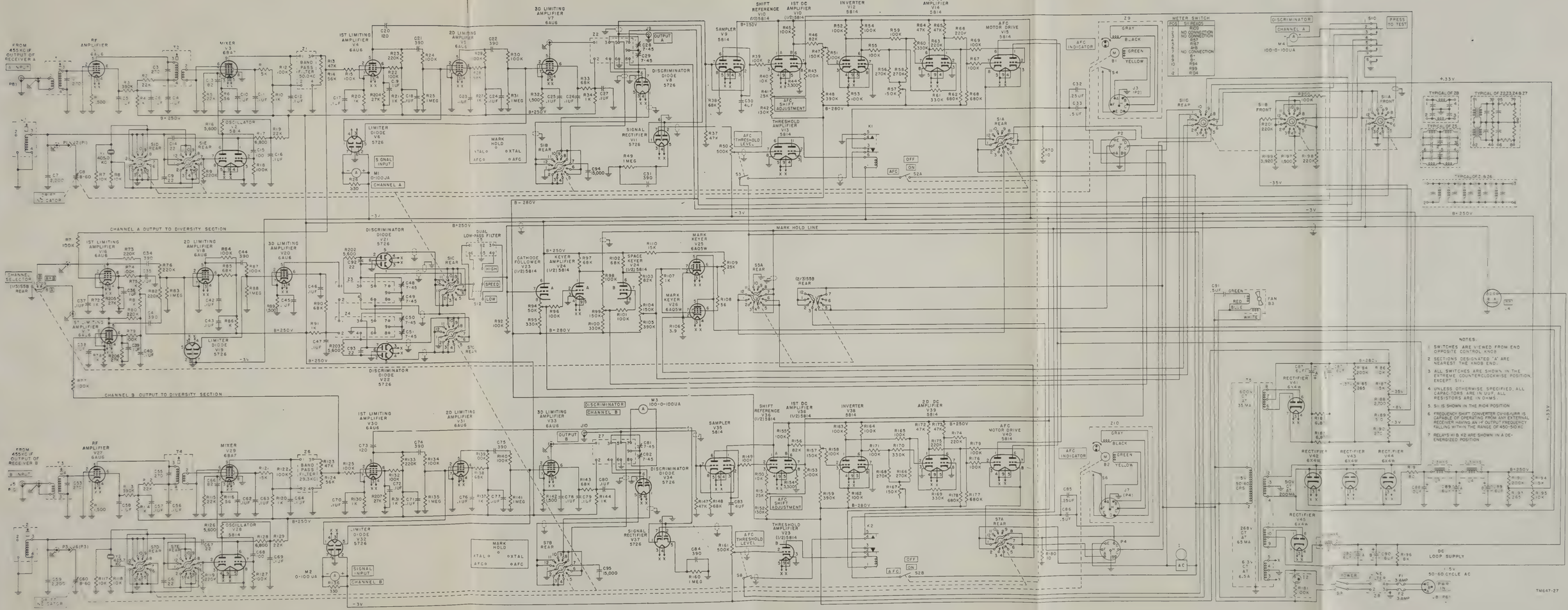


Figure 43. Frequency Shift Converter CV-116/URR, schematic diagram.

INDEX

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For explanation of abbreviations used, see SR 320–50–1.

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